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HYDROGEOCHEMICAL AND STREAM SEDIMENT DETAILED GEOCHEMICAL SURVEY FOR EDGEMONT, SOUTH DAKOTA; WYOMING

T. R. Butz, N. E. Dean, C. S. Bard,
R. N. Helgerson, J. G. Grimes, and P. M. Pritz
Uranium Resource Evaluation Project

May 31, 1980

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UNION CARBIDE CORPORATION
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Uranium Resource Evaluation Project

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Oak Ridge, Tennessee

Prepared for the U. S. Department of Energy
Assistant Secretary for Resource Applications
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REA

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ABSTRACT

Results of the Edgemont detailed geochemical survey are reported. Field and laboratory data are presented for 109 groundwater and 419 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed.

Groundwaters containing ≧7.35 ppb uranium are present in scattered clusters throughout the area sampled. Most of these groundwaters are from wells drilled where the Inyan Kara Group is exposed at the surface. The exceptions are a group of samples in the northwestern part of the area sampled and south of the Dewey Terrace. These groundwaters are also produced from the Inyan Kara Group where it is overlain by the Graneros Group and alluvium. The high uranium groundwaters along and to the south of the terrace are characterized by high molybdenum, uranium/specific conductance, and uranium/sulfate values. Many of the groundwaters sampled along the outcrop of the Inyan Kara Group are near uranium mines. Groundwaters have high amounts of uranium and molybdenum. Samples taken downdip are sulfide waters with low values of uranium and high values of arsenic, molybdenum, selenium, and vanadium.

Stream sediments containing ≧5.50 ppm soluble uranium are concentrated in basins draining the Graneros and Inyan Kara Groups. These values are associated with high values for arsenic, selenium, and vanadium in samples from both groups. Anomalous values for these elements in the Graneros Group may be caused by bentonite beds contained in the rock units. As shown on the geochemical distribution plot, high uranium values that are located in the Inyan Kara Group are almost exclusively draining open-pit uranium mines.

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HYDROGEOCHEMICAL AND STREAM SEDIMENT DETAILED GEOCHEMICAL SURVEY FOR EDGEMONT, SOUTH DAKOTA; WYOMING

INTRODUCTION

The National Uranium Resource Evaluation (NURE) Program was established by the U. S. Atomic Energy Commission (AEC), now the U. S. Department of Energy (DOE), in the spring of 1973 to assess uranium resources and to identify favorable areas for detailed uranium exploration throughout the United States. The principal objectives of the NURE Program are: (1) to provide a comprehensive in-depth assessment of the nation's uranium resources for national energy planning, and (2) to identify areas favorable for uranium resources. A NURE Program report covering uranium resource assessment in 116 National Topographic Map Series (NTMS) 1° x 2° quadrangles, which contain 100% of the currently estimated uranium resources, is targeted for 1980. The complete resource assessment of the 272 highest-priority quadrangles is scheduled for completion in 1985, and the first comprehensive assessment report of the entire United States is scheduled for completion in 1988. This program, which is being administered by DOE, is expected to increase the activity of commercial exploration for uranium in the United States.

The NURE Program consists of five parts:

1. Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) Program,
2. Aerial Radiometric and Magnetic Survey,
3. Surface Geologic Investigations,
4. Drilling for Geologic Information, and
5. Geophysical Technology Development.

The objective of the HSSR Program is to provide information to be used in accomplishing the overall NURE Program objectives. This is accomplished by a reconnaissance of surface water, groundwater, stream sediment, and lake sediment. The survey is being conducted by three Government-owned laboratories. Union Carbide Corporation, Nuclear Division (UCC-ND), under contract with DOE, is conducting its survey in 154 NTMS 1° x 2° quadrangles which cover approximately 2,500,000 km^2 (1,000,000 mi^2) of the Central United States. This area includes most of the states of Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Minnesota, Wisconsin, Michigan, Indiana, Illinois, and Iowa, as well as parts of Arkansas, Missouri, New Mexico, and Ohio.

As a part of the HSSR Program, detailed geochemical surveys were initiated in the fall of 1978 to supply comprehensive detailed geochemical data from specific areas. These surveys are designed to characterize the hydrogeochemistry, stream sediment geochemistry, and/or radiometric patterns of known or potential uranium occurrences. These data can be used to interpret data from the 1° x 2° NTMS quadrangle basic data surveys. Described herein are the results of the work done by UCC-ND in the Edgemont project area, South Dakota; Wyoming (see Figure 1).

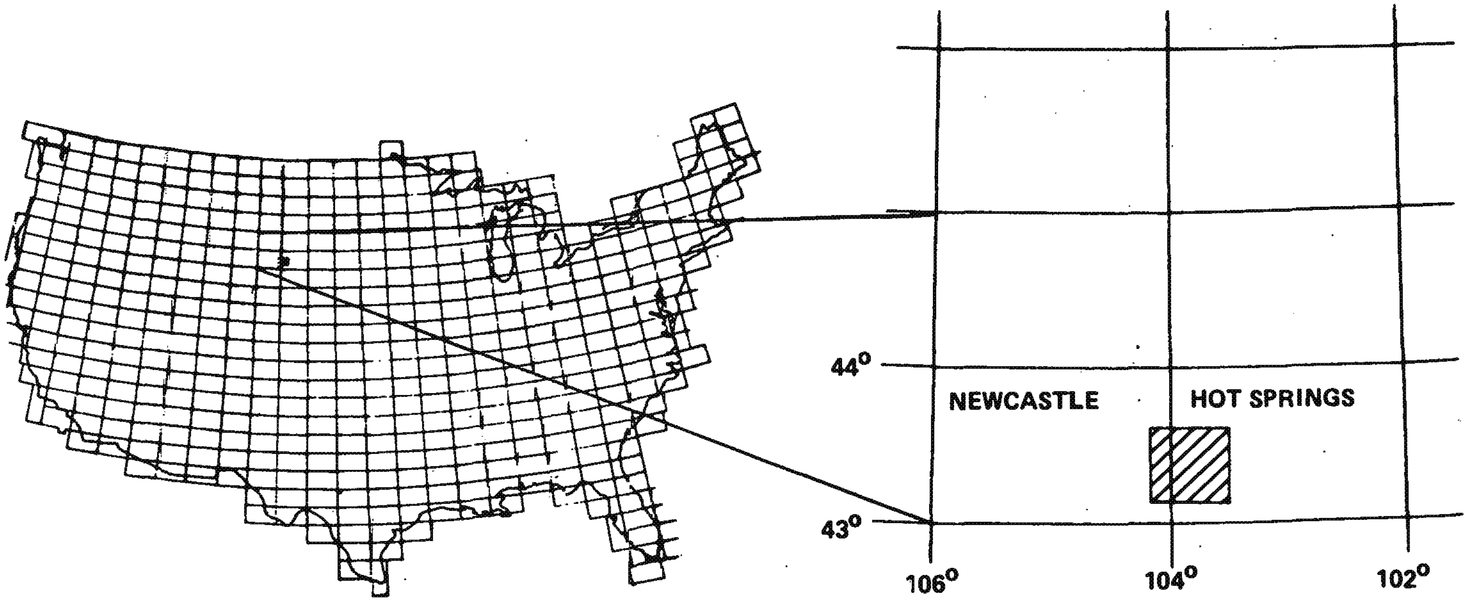

Figure 1

INDEX MAP SHOWING THE BOUNDARIES FOR THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

LOCATION AND PHYSIOGRAPHY

The Edgemont detailed geochemical project area includes approximately 2,220 km^2 (854 mi^2) in southwestern South Dakota and east central Wyoming. The project area lies between lat. 43°07'30" and 43°37'30" and long. 103°30' and 104°07'30" and includes parts of Fall River and Custer Counties, South Dakota and parts of Niobrara and Weston Counties, Wyoming (Figure 2).

The project area lies within two physiographic provinces, the Great Plains and the Black Hills. These two regions are divided by the Cheyenne River, which is the major surface drainage system for the project area. The Cheyenne River generally follows the contact between the Graneros Group shales and the sandstones of the Inyan Kara Group. The Inyan Kara Group to the north of the Cheyenne River forms hogbacks through which streams have incised deep northwest-southeast trending canyons. South of the Cheyenne River are the rolling grasslands of the Great Plains Province. A generalized geologic map of the Edgemont detailed geochemical survey project area, along with a stratigraphic column listing geologic codes used in this report, is presented in Figure 3 and Plate 7.

CLIMATE

The Edgemont project area lies within a semiarid region. The annual precipitation averages about 41 cm (16 in.) and occurs in April through September with a maximum during June (National Oceanic and Atmospheric Administration, 1974). Mean annual temperature is approximately 10°C (49°F); however, temperatures of 39°C (100°F) or higher are experienced during summer months.

RELATED STUDIES

The project area has known uranium mineralization and was extensively mined during the 1950's. During this time, the U.S. AEC funded studies of the uranium district surrounding the town of Edgemont. Most of these studies were done by the U.S. Geological Survey (USGS). Publications include the following: (1) papers by Jones, Frost, and Rader (1957) and Bell and Bales (1954); and (2) USGS Bulletins and geologic maps by Bell and Post, (1971); Braddock (1957, 1963); Brobst (1961); Gott and Schnabel (1963); Ryan (1964); Schnabel (1964); Wilmarth and Smith (1957); and Wolcott, Bowles, Brobst, and Post (1962). Reports by the Raw Materials Division of the U.S. AEC include Casey and Wescott (1957), Illsley (1957), and Illsley and Scott (1956). Gott, Wolcott, and Bowles (1974) describe the accepted source areas for the sediments of the Inyan Kara Group and the method of deposition of uranium in that unit.

Aerial gamma ray and magnetic surveys have been flown for the Hot Springs NTMS Quadrangle for the NURE Program. The report on this area indicates "significant" anomalies in rock units of Jurassic, Triassic, and Cretaceous age. These anomalies appear to follow the known mining district (Texas Instruments, Inc., 1979).

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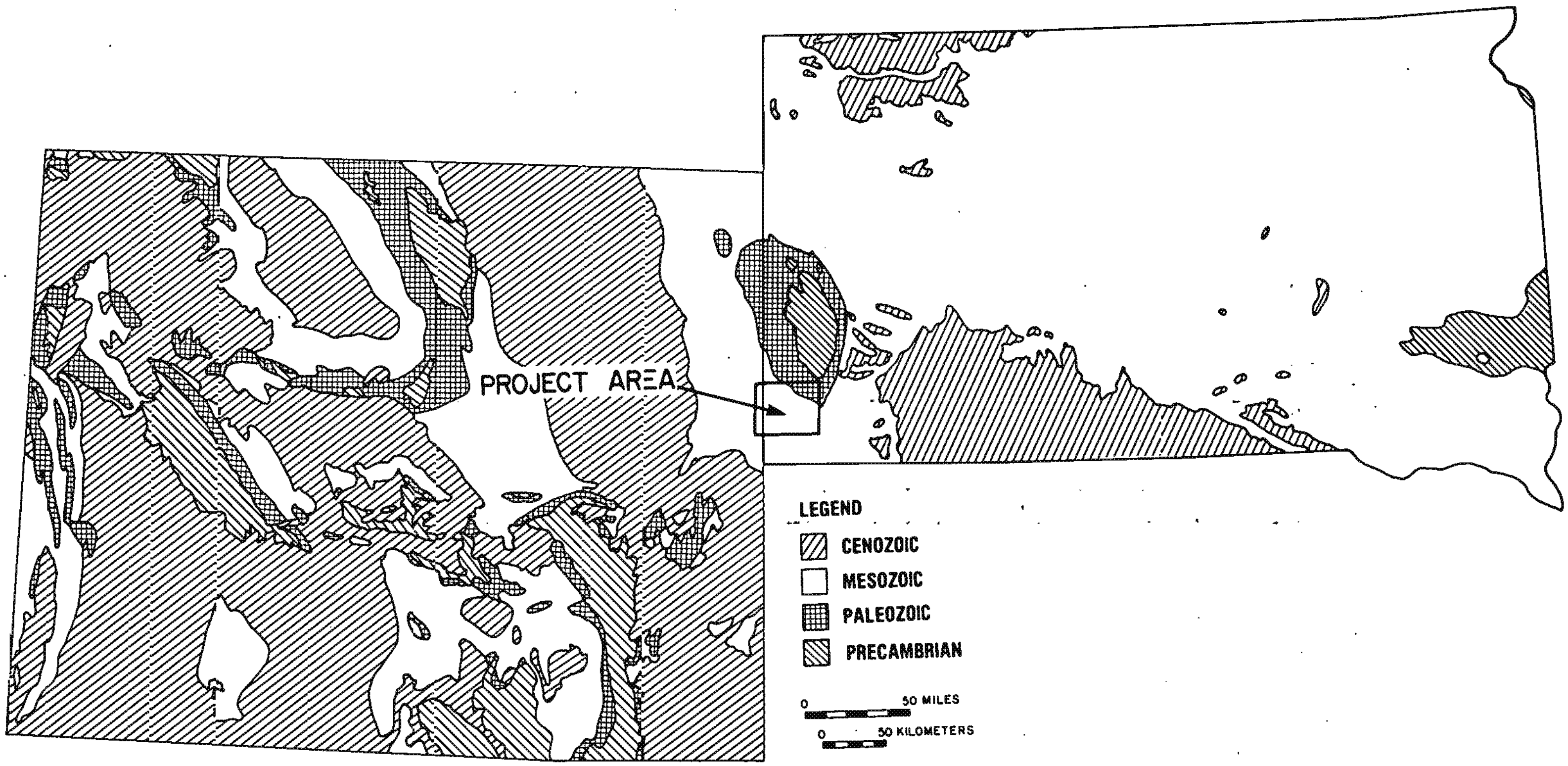


Figure 2

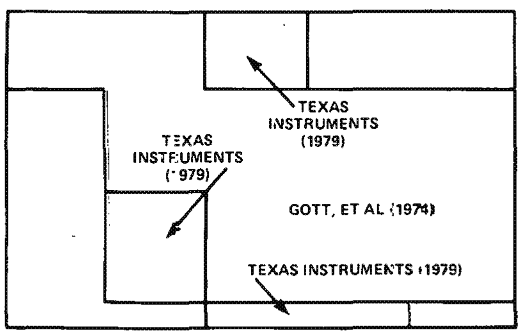
GENERALIZED GEOLOGIC MAP OF SOUTH DAKOTA WITH LOCATION
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING
(AFTER KING, ET AL, 1974)

STRATIGRAPHIC COLUMN OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY

ERA	SYSTEM	GEOLOGIC MAP CODE	GEOLOGIC GROUP	GEOLOGIC FORMATIONS	GEOLOGIC MEMBER	MAXIMUM THICKNESS METERS	MAXIMUM THICKNESS FEET
CENOZOIC	QUATERNARY	QAL		ALLUVIUM, TERRACE DEPOSITS			
MESOZOIC	CRETACEOUS	KNC		NIOBRARA MARL AND CARLILE SHALE, UNDIVIDED		76	250
		KGCG		GREENHORN LIMESTONE		76	250
		KGDS	GRANEROS GROUP	BELLE FOURCHE SHALE, MOWRY SHALE, NEWCASTLE SANDSTONE, AND SKULL CREEK SHALE		265	870
		KFL	INYAN KARA GROUP	FALL RIVER FORMATION		201	660
				LAKOTA FORMATION	FUSON MEMBER MINNEWASTE MEMBER CHILSON MEMBER		
	JURASSIC	JMOR		UNKPAPA SANDSTONE AND MORRISON FORMATION, UNDIVIDED		113	370
		JRSU		SUNDANCE FORMATION		122	400
	TRIASSIC	TRSP		SPEARFISH FORMATION		169	556
PALEOZOIC	PERMIAN	PEMO		MINNEKAHTA LIMESTONE AND OPECHE SHALE		41	135
	PENNSYLVANIAN	PMIN		MINNELUSA FORMATION		305	1,000
	MISSISSIPPIAN			PAHASAPA FORMATION		76	250

SOURCES:

1. GOTT, G. B., WOLCOTT, D. E., AND BOWLES, C. G., "STRATIGRAPHY OF THE INYAN KARA GROUP AND LOCALIZATION OF URANIUM DEPOSITS, SOUTHERN BLACK HILLS, SOUTH DAKOTA AND WYOMING," U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 763 (1974).
2. KEENE, J. R., "GROUNDWATER RESOURCES OF THE WESTERN HALF OF FALL RIVER COUNTY, SOUTH DAKOTA," SOUTH DAKOTA GEOLOGICAL SURVEY, REPORT OF INVESTIGATIONS NO. 109 (1973).
3. POST, E. V., "GEOLOGY OF THE CASCADE SPRINGS QUADRANGLE, FALL RIVER COUNTY, SOUTH DAKOTA," U.S. GEOLOGICAL SURVEY BULLETIN 1063-L (1967).
4. TEXAS INSTRUMENTS CORPORATION, "GEOLOGIC MAP OF THE HOT SPRINGS QUADRANGLE" (1979).



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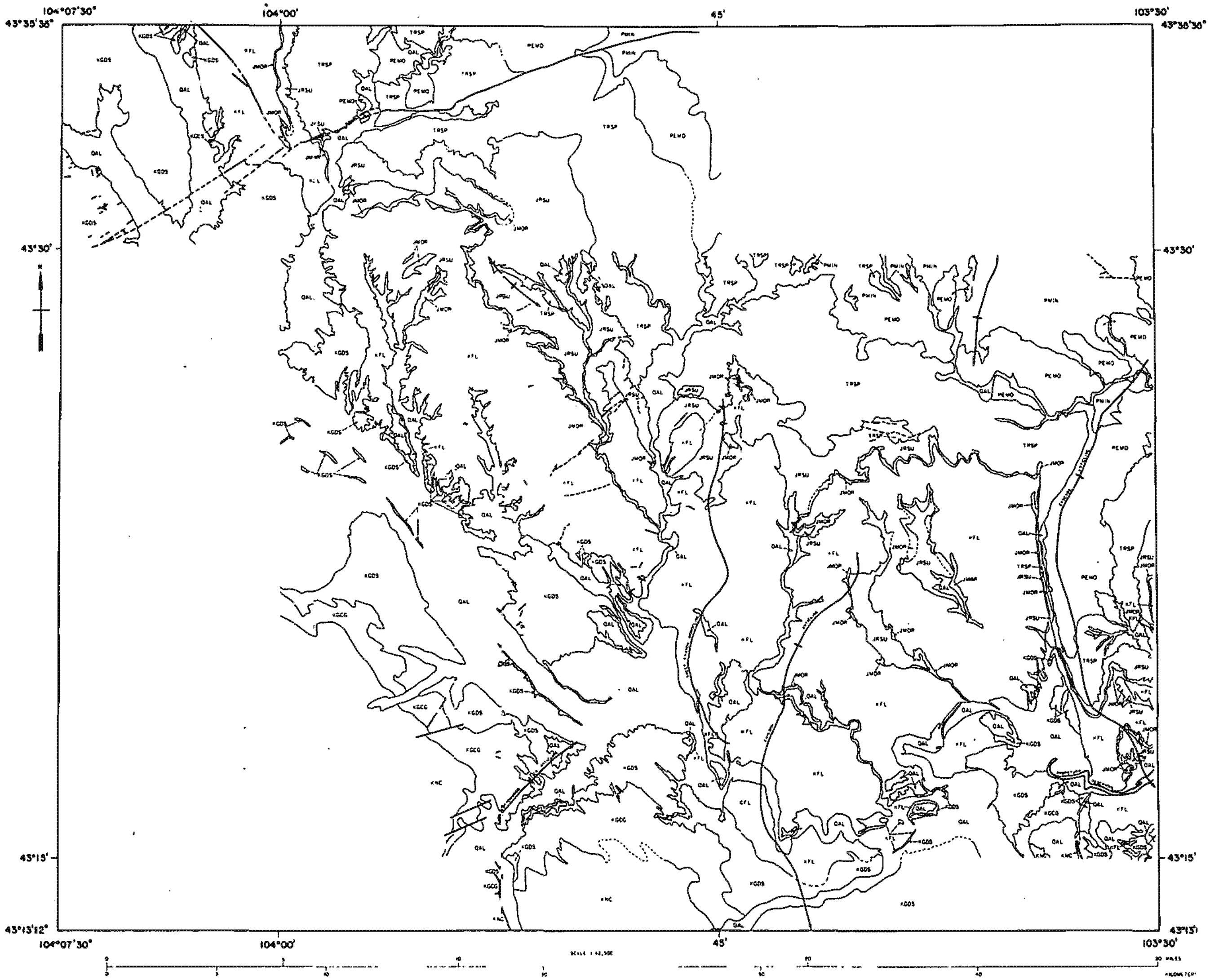

Figure 3

GENERALIZED GEOLOGIC MAP OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

Reconnaissance geochemical sampling for the Hot Springs NTMS Quadrangle was completed in 1979 by UCC-ND for the NURE Program. Groundwater data show signficant amounts of uranium from the same units described as being anomalous by the aerial gamma ray and magnetic surveys (Uranium Resource Evaluation Project, December 1979).

GEOLOGY

STRATIGRAPHY

Pennsylvanian and Permian units crop out in and to the north of the area sampled. Mesozoic shales, sandstones, marls, and limestones are the predominant units in the project area. They include the Permo-Triassic Spearfish Formation, the Jurassic Sundance Formation, and the Unkpapa Sandstones and Morrison Formation. Lower Cretaceous units cover the largest area and include the Inyan Kara Group and units of the Graneros Group (Skull Creek Shale, Newcastle Sandstone, and Mowry Shale). Upper Cretaceous units are the Belle Fourche Shale of the Graneros Group, Greenhorn Limestone, Niobrara Marl, and Carlile Shale, all of which crop out in the southern part of the project area. Alluvium from the Cheyenne River covers the Graneros and Inyan Kara Groups in the central section of the project area.

Although the Pahasapa Formation of Mississippian age does not crop out in the project area, it is reported here because of its potential as an aquifer in the project area. It is a gray to buff, massive limestone with thin layers of chert and laterite. The Pahasapa Formation is as much as 12,400 m (4,000 ft) below the surface within the project area.

The Minnelusa Formation is Pennsylvanian to Permian in age. An extensive red mudstone locally called the "Red Marker" is considered the division between the two systems. Below the "Red Marker" bed, the Minnelusa Formation is composed of limestone, dolomite, shale, and sandstone. The upper unit consists of alternating beds of anhydrite, sandstone, and dolomite. Approximately 1,000 ft of the Minnelusa Formation is present within the project area (Braddock, 1963).

The Opeche Shale crops out in the northern section of the area sampled in Hell Canyon. It is primarily a red mudstone with several thin gypsum beds. Overlying the Opeche Shale is the Minnekahta Limestone. The Minnekahta Limestone is composed of beds of fossiliferous, pure to argillaceous limestone, and reddish-brown to reddish-gray limestone.

The Spearfish Formation is a nonresistant series of red siltstones, red sandstones, and gypsum with some carbonate beds. Within the project area, three units of the Spearfish Formation have been mapped by Braddock (1963) and Post (1967). The lower two units contain the gypsum beds. In age determinations, correlations have been made with units in Wyoming, and the top of the Permian has been placed in the middle unit of the Spearfish Formation at the uppermost gypsum bed. The age of the Spearfish Formation is considered to be Late Permian and Triassic. Subsurface logs indicate that the Spearfish Formation can be up to 169 m (556 ft) thick within the project area (Keene, 1973).

The Sundance Formation lies unconformably on the Spearfish Formation. This erosional unconformity represents part of the Triassic and all of the Early and Middle Jurassic. The Sundance Formation is Late Jurassic in age. The thickness of the formation in its outcrop area ranges from 91 to 122 m (300 to 400 ft). It consists of orange-red fine-grained sandstones, olive-gray fossiliferous shales, argillaceous siltstone with some thin limestone beds, and glauconitic sandstones. According to Braddock (1963), the Sundance Formation was deposited in a marine shelf environment that extended northwestward between the Williston Basin in North Dakota and the Twin Creek Trough in southwestern Wyoming.

Overlying the Sundance Formation throughout most of the project area is the Morrison Formation of Late Jurassic age. The Morrison Formation is poorly exposed throughout the project area, but has been measured up to 37 m (120 ft) in the western part (Post, 1967). The Morrison Formation is nonmarine and principally a gray-green mudstone with thin discontinuous beds of limestone. Braddock (1963) suggests that owing to the lack of channel sandstones and the abundance of clay and limestone that the Morrison was deposited in an area of poor drainage and abundant ponds. The Morrison Formation thins out in the eastern section of the survey area.

The Unkpapa Sandstone has a limited extent within the survey area. It is considered Late Jurassic due to its stratigraphic position beneath the Morrison Formation in a few locations. The Unkpapa Sandstone consists of a fine-grained, orange-red sandstone with indistinct crossbeddding, very fine-grained maroon to yellow-orange siltstone, and an upper unit of varicolored argillaceous siltstone and claystone. This upper unit is not always present owing to a pre-Lakota period of erosion. The entire unit has been measured up to 77 m (250 ft) thick within the project area. The Unkpapa Sandstone is considered terrestrial in origin. Post (1967) suggests that it represents a transition from an eolian to a paludal environment.

The Inyan Kara Group is of Early Cretaceous age. The group contains two formations, the Lakota and Fall River, which reach a combined thickness of up to 205 m (660 ft) in the project area. The Lakota Formation consists of these three members: Chilson, Minnewaste, and Fuson. The Chilson Member is primarily composed of two fluvial units and consists of a series of sandstones, shales, siltstones, and mudstones laid down as stream and floodplain deposits. Carbonized plant remains are common in the lower unit. The Minnewaste Member overlies these fluvial units. It grades from an almost pure limestone in its thickest section to a calcareous sandstone at the margins of the deposit. This, along with its limited distribution and presence of fresh water sponge spicules, indicates that the Minnewaste Member is lacustrine in origin (Gott, et al, 1974). The Fuson Member in the project area is primarily a mudstone. The lower part interfingers with a conglomeratic sandstone and channels at the top are filled with a fluvial sandstone. The Fall River Formation is a group of carbonaceous siltstones and fine-grained sandstones cut and overlain by two separate fluvial units. Petrographic studies made by Gott, et al (1974) show a change of sediment source areas over the period of deposition of the Inyan Kara Group. The first two fluvial units from the Lakota Formation had a western source area, which included ash and tuff from volcanic activity. The fluvial units in the Fuson Member show a transition from a western source area to an eastern source of sediment by the middle of Fall River time.

The Graneros Group is a name given to four units that are Early to Late Cretaceous in age by the South Dakota Geological Survey. According to Keene (1973), they may be up to 265 m (870 ft) thick in the western half of Fall River County, South Dakota where most of the project area lies. The oldest unit is the Skull Creek Shale, which is a gray to black marine shale locally interbedded with siltstone and sandstone. Calcareous concretions and thin limestone beds with cone-in-cone structure are present within the unit. The Skull Creek Shale has a gradational contact with the underlying Inyan Kara Group. Stratigraphically above the Skull Creek Shale is the Newcastle Sandstone. The Newcastle apparently does not overlie the Skull Creek Shale everywhere within the project area. Where it is described, it appears to be thin discontinuous beds of sandstone. The Mowry Shale overlies the Skull Creek Shale in most of the project area and is considered to be the last of the Early Cretaceous units in the Black Hills. The contact between the Mowry and Skull Creek is marked by the Clay Spur bentonite bed. The Mowry Shale is a medium to dark gray shale that typically weathers to light gray or silver in outcrop. The Mowry Shale is also characterized by numerous sandstone dikes. Overlying the Mowry Shale is the Belle Fourche Shale, a Late Cretaceous black marine shale with some beds of bentonite and zones of iron-manganese carbonate concretions.

The Greenhorn Limestone (Late Cretaceous) is a prominent ridge former in the southern Black Hills. It is approximately 77 m (250 ft) thick and includes a lower thick section of olive gray to yellow brown shales and an overlying limestone unit. Overlying the Greenhorn Limestone, in the southern part of the project area, is the Carlile Shale of Late Cretaceous age. The Carlile Shale is a sequence of sandstone and gray shales with limestone concretions. A measured section east of the survey area indicates the Carlile Shale is up to 77 m (250 ft) thick (Post, 1967). Above the Carlile Shale is the Niobrara Marl (Late Cretaceous), which is 62 to 77 m (200 to 250 ft) of gray to yellow marl and chalk (Keene, 1973).

Quaternary alluvial deposits in the project area include terrace deposits and alluvium. Terrace deposits along the Cheyenne River and larger stream basins are often composed of older Paleozoic and Precambrian rocks north of the project area (Gott and Schnabel, 1963). Other terrace deposits include sediments from the nearby Cretaceous rocks, and Ryan (1964) suggests that this represents a reworking of the earlier gravels by the Cheyenne River. Alluvial deposits of sand and silt are extensive on the floodplain of the Cheyenne River and are variable in thickness.

STRUCTURE

The project area lies on the southern end of the Black Hills Uplift, a north-northwest trending dome that probably formed during Laramide time.

Two south-plunging anticlines dominate the eastern part of the project area. The Cascade Anticline is the largest with an amplitude of 3,900 m (1,300 ft) (Gott, et al, 1974) and a steeply dipping western flank with a mildly dipping eastern flank. It forms topographic highs where the resistant Inyan Kara Group crops out. The Chilson Anticline is approximately 12.9 km (8 mi) west of the Cascade Anticline. It also forms ridges along its axis in the Inyan Kara Group. Other anticlines in the project area have little or no surface expression.

In the northwestern part of the project area, two major monoclines border the Dewey Structural Terrace (Brobst, 1961). The Fanny Peak Monocline on the western side of the terrace only extends slightly into the project area, but is a major structure in the region as it separates the Black Hills Uplift and the Powder River Basin to the west. The gently western dipping beds of the Black Hills Monocline are the strata in which the Elk Mountains are cut. The south-plunging Sheep Canyon Monocline (Gott, et al, 1974) lies 4 km (2.5 mi) east of Edgemont. This monocline is bounded on the east by the Livingston Terrace and on the west by the Edgemont Terrace.

Two structural zones extend from the western to the central part of the project area. The Dewey Structural Zone is a fault zone of steeply dipping to vertical normal faults. The northern side of the faults are upthrown with as much as 155 m (500 ft) of displacement (Gott, et al, 1974). The Long Mountain Structural Zone is not as well defined as the Dewey. It consists of many small northeast-trending normal faults. Breccia pipes and collapse structures are numerous in the project area and are formed by the solution of beds of gypsum, anhydrite, dolomite, and limestone in artesian waters. Breccia pipes slope upward for hundreds of meters from the Pahasapa Formation into the overlying formations. These pipes appear to be structurally controlled by zones of intense fracturing and faulting. They are commonly located in the Dewey and Long Mountain Structural Zones.

HYDROLOGY

The principal aquifers of the project area are the Fall River and Lakota Formations of the Inyan Kara Group. The Fall River Formation is the larger producing aquifer. Both produce artesian water and a large number of the wells drilled into these formations flow.

Recharge of the Inyan Kara aquifers does not occur where it is exposed at the surface. Gott, et al (1974) cites studies indicating imperceptible stream loss to the Inyan Kara Group. These aquifers are recharged instead by artesian waters from the Minnelusa Formation which move upward through collapse and breccia pipes and along fault zones. These waters change in composition during their migration from a calcium-sulfate type as it rises through the various structures into the Inyan Kara Group to a sodium-sulfate type as it moves basinward through the permeable zones of the Inyan Kara Group. This change is interpreted as a natural base exchange which softens the water (Gott, et al, 1974). A further alteration occurs locally where the sodium-sulfate type water is changed to a sodium-bicarbonate type. This process occurs due to reduction of sulfate to hydrogen sulfide by bacteria present in carbonaceous materials within the Inyan Kara Group. According to Keene (1973), hydrogen sulfide in well water is concentrated in areas where a transformation over a short distance from calcium-sulfate water to sodium-bicarbonate water is made. This is due to two factors. The first is a decrease in permeability of the rock which slows movement of the water and allows time for the cation exchange needed to make the change to a sodium-sulfate water. The second factor is confinement and reaction with carbonaceous material which produces a reducing environment which reduces sulfate to sulfide resulting in sodium-bicarbonate waters.

Other aquifers in the project area include alluvium, the Sundance Formation, and the Pahasapa Formation.

Keene (1973) considers the water from the Pahasapa Formation to be some of the best water in Fall River County and to have excellent potential as an aquifer. However, in the project area, the Pahasapa Formation can be as much as 12,400 m (4,000 ft) below the surface and can be up to 59°C (139°F) in temperature. Its use is not widespread.

The Sundance Formation produces water in the southern Black Hills in areas where it crops out. Water downdip has proved to be brackish with high amounts of dissolved solids.

Shallow wells are drilled in alluvium along major streams and the Cheyenne River. They are usually hand dug or rotary drilled and have concrete casing.

The Graneros Group, Morrison Formation, Unkpapa Sandstone, and Spearfish Formation yield small amounts of very poor-quality water. The Minnelusa Formation is thought to be the source of a number of springs in the project area, notably those at Cascade Springs (Keene, 1973).

URANIUM OCCURRENCES

Uranium was first discovered in the southern Black Hills in 1951. Extensive mining operations throughout the area, along with a detailed mapping study and evaluation of the ore deposits, took place during the 1950's and early 1960's. The mining district stretches from the Elk Mountains in Wyoming southeastward through Custer and Fall River Counties, South Dakota, passing north of Edgemont and ending west of the Angostura Reservoir.

Ore deposits were found to be restricted to four stratigraphic units within the Inyan Kara Group. They are the lower unit of the Fall River Formation, the fluvial sandstone Unit 5 in the Fall River Formation, the fluvial Unit 4 in the Fuson Member of the Lakota Formation, and the fluvial Unit 1 in the Chilson Member of the Lakota Formation (Gott, et al, 1974). Principal ore minerals are carnotite, tyuyamunite, corvusite, and rauvite.

Controls on the placement of ore bodies are varied. Permeability, water chemistry, and all structures play a part in ore deposition. Increased permeability of channel sandstones allows rapid flow of large volumes of aqueous solutions through these fluvial units. Impermeable units, such as the various mudstones and siltstones that interfinger with the channel sandstones, slow this flow, and according to Keene (1973) produce reducing zones. Braddock (1957), Cuppels (1962), and Bell, et al (1955) note uranium deposits at the interface of these rock types. The mineralizing solutions are considered to have been the calcium-sulfate water that recharges the Inyan Kara Group from the Minnelusa Formation (Gott, et al, 1974). Three sources of the uranium in the waters have been suggested. They are (1) Precambrian granites exposed to the north of the project area, (2) sedimentary rocks of the Paleozoic and Mesozoic, and (3) the Tertiary White River Group which contains volcanic ash and which supposedly overlaid this area at one time. There is an apparent decrease in the uranium concentration in groundwaters as they move basinward and the calcium-sulfate water is modified to a sodium-sulfate and sodium-bicarbonate water. This decrease in uranium in solution is interpreted by Gott, et al (1974) as a result of precipitation of uranium. According to studies made by Gott, et al (1974), calcium-sulfate waters in the Inyan Kara Group having high uranium values also have high redox and pH values, indicating an oxidized zone. Sodium-sulfate and sodium-bicarbonate waters with low uranium values have low redox and pH values, indicating a reducing zone.

Uranium deposits are found as both oxidized and reduced ore. Bell, et al (1955) notes the deposits that he studied are located in areas of sudden changes in dip or along margins of structural terraces. Braddock (1957) indicates uranium occurrences on Long Mountain, South Dakota are between two faults. These faults could serve as conduits for mineralizing solutions as breccia pipes do elsewhere in the project area. Calcium-carbonate cement has long been recognized as being spatially related to the ore deposits. Numerous calcite cemented breccia pipes indicate the upwelling Minnelusa Formation waters as the source for the calcite cement as well as the uranium.

SAMPLE COLLECTION

CHRONOLOGY OF THE SURVEY

Sampling for the Edgemont detailed geochemical survey took place during August 1979. Laboratory analysis and compilation and verification of the field and laboratory data base used to prepare the statistical and areal distribution of uranium and other related variables for this report were completed in February 1980.

FIELD PROCEDURES

Field sampling was performed by personnel of the South Dakota Geological Survey. A total of 109 groundwater and 419 stream sediment samples was collected within the survey area. Spring water and well water samples are combined and reported as groundwater. Plates 1 and 4 show sample locations for groundwater and stream sediment sites, respectively. Drainage basins are drawn in on Plate 4 to indicate the area represented by the stream sediment samples. Due to the sparse population and an accompanying lack of wells, sample coverage for groundwater is limited.

Detailed information regarding techniques in sample collection, recording site data, field equipment, and field measurements may be found in the following reports: "Hydrogeochemical and Stream Sediment Reconnaissance Procedures for the Uranium Resource Evaluation Project" (Arendt, et al, December 1979); "Procedures Manual for Groundwater Reconnaissance Sampling" (Uranium Resource Evaluation Project, March 1978); and "Procedures Manual for Stream Sediment Reconnaissance Sampling" (Uranium Resource Evaluation Project, May 1978). Field observations were recorded on the field form shown in Table C-2 and are included in the microfiche in Appendix D.

CONTAMINATION

Precautions were taken to avoid the possibility of collecting contaminated samples. Wells which were affected by any chlorination, water-softening, or filtering devices were not sampled if a sample could not be taken before the water passed through such devices. Any well that had not been pumped recently was allowed to run long enough to flush the system, and the fact that it had no recent use was noted on the field form. Since the possibility for contamination is high in dug wells, these were noted on the field form. Any wells that the sampler had reason to suspect might be contaminated were noted as such on the field form.

Sediment samples were collected upstream from road crossings, where possible. Visible signs of contamination upstream from a sample site were noted on the field form.

Uranium mining has been a major industry throughout most of the survey area for the past 30 years. Active exploration is being carried on presently by a number of mining firms. Old mines are both pit and shaft operations. These mines have not been filled or reclaimed. Some drill holes have not been properly cased or plugged (Keene, 1973) and may be a possible source of contamination. A uranium mill was operated in the town of Edgemont during the 1950's. Tailings from this mill were buried around several local communities and a survey by the Environmental Protection Agency and U.S. AEC in 1972 showed 49 radioactive anomalies (Nuclear Fuel, 1980).

CHEMICAL ANALYSIS

All samples collected in the field geology program were returned to the URE Project laboratory in Oak Ridge, Tennessee for preparation and analysis. The elements determined and the analytical techniques used along with the appropriate detection limits are given in Table 1. These detection limits are considered the best average during normal operation; however, some variables have values reported below these limits. All water samples were received in 250-ml polyethylene bottles and were filtered through 0.45-μm cellulose acetate paper. Stream sediment sam-

Table 1

DETECTION LIMITS OF VARIABLES DETERMINED IN WATER AND SEDIMENT SAMPLES

Variable	Method	Detection Limit Sediment (ppm)	Detection Limit Water (ppb)
U-FL	Fluorometry	0.25	0.2
U-MS	Mass Spectrometry-Isotope Dilution	--	0.02
U-NT	Neutron Activation-Delayed Neutron Count	0.02	--
As	Atomic Absorption	0.1	0.5
Se	Atomic Absorption	0.1	0.2
Ag	Plasma Source Emission Spectrometry	2	2
Al	Plasma Source Emission Spectrometry	0.05[a]	10
B	Plasma Source Emission Spectrometry	10	8
Ba	Plasma Source Emission Spectrometry	2	2
Be	Plasma Source Emission Spectrometry	1	1
Ca	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Ce	Plasma Source Emission Spectrometry	10	30
Co	Plasma Source Emission Spectrometry	4	2
Cr	Plasma Source Emission Spectrometry	1	4
Cu	Plasma Source Emission Spectrometry	2	2
Fe	Plasma Source Emission Spectrometry	0.05[a]	10
Hf	Plasma Source Emission Spectrometry	15	--
K	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
La	Plasma Source Emission Spectrometry	2	--
Li	Plasma Source Emission Spectrometry	1	4
Mg	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Mn	Plasma Source Emission Spectrometry	4	2
Mo	Plasma Source Emission Spectrometry	4	4
Na	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Nb	Plasma Source Emission Spectrometry	4	--
Ni	Plasma Source Emission Spectrometry	2	4
P	Plasma Source Emission Spectrometry	5	40
Sc	Plasma Source Emission Spectrometry	1	1
Si	Plasma Source Emission Spectrometry	--	0.1[b]
Sr	Plasma Source Emission Spectrometry	1	2
Th	Plasma Source Emission Spectrometry	2	--
Ti	Plasma Source Emission Spectrometry	10	2
V	Plasma Source Emission Spectrometry	2	4
Y	Plasma Source Emission Spectrometry	1	1
Zn	Plasma Source Emission Spectrometry	2	4
Zr	Plasma Source Emission Spectrometry	2	2
SO_4	Spectrophotometry	--	5[b]
Cl	Spectrophotometry	--	10[b]

[a]Detection limits expressed in percent.
[b]Detection limits expressed in ppm.

ples were dried overnight at 85°C and sieved to collect the <150-μm fraction. Part of the sediment sample was dissolved in 10 ml of 1:1 nitric-hydrofluoric acid. The analytical procedures which were used have been described by Cagle (1977) and Arendt, et al (December 1979). All observed data from all samples are included in the microfiche in Appendix D.

QUALITY CONTROL

MEASUREMENTS CONTROL

The procedures used to analyze URE Project samples require that calibration standards, check samples, and blanks be analyzed along with normal samples to ensure the validity of the reported results. A measurements control program provides information concerning precision and reliability of these measurements. Control samples of two water batches and two sediment batches are submitted anonymously along with routine samples on a daily basis. A statistical summary of results reported on control samples, which were analyzed along with the samples included in this survey, is given in Table 2. Results of uranium analysis of water and sediment control samples obtained from the Ames Laboratory as part of the Multilaboratory Analytical Quality Control for the HSSR Program are reported by D'Silva, et al (1979).

PRINCIPAL COMPONENT ERROR ANALYSIS

A principal component analysis of data from well water and stream sediment samples was used to produce an ordered list of samples using the eigenvalue statistics as described by Kane, et al (1977), where the most extreme samples were listed first. Additional unusual samples were identified if single-element measurements were outside a three standard deviation confidence interval around the mean. The laboratory and field data from the unusual samples identified by this procedure were reviewed. Two well water samples (405357 and 406443) and four stream sediment samples (404881, 405081, 405234, and 405324) which appeared to be the most unusual were submitted for reanalysis. The original results were compared to the results from reanalysis. Of the more than 150 individual analyses that were compared, the only results which were considered to be in error in the original analysis and thus require corrections were multielement values for Water Sample 406443 and a uranium fluorometric value for Sediment Sample 405324. This low error rate for the unusual samples indicates a high level of reliability for the laboratory measurements.

GEOCHEMICAL RESULTS

GEOCHEMICAL DISTRIBUTIONS IN GROUNDWATER

The sample site locations for groundwater samples collected in the Edgemont detailed geochemical survey are shown on Plate 1. Symbol plots for uranium and specific conductance are presented on Plates 2 and 3 and

Table 2

SUMMARY OF MEASUREMENTS CONTROL RESULTS OBTAINED WITH SAMPLES FROM THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

		Measurements Control Results for Water							
		Batch L-4				Batch H-4			
Element	Method	No. of Samples	Mean (ppb)	Standard Deviation (ppb)	Coefficient of Variation	No. of Samples	Mean (ppb)	Standard Deviation (ppb)	Coefficient of Variation
U	MS[a]	1	0.52	0.0	0.0	3	9.92	0.496	0.05
U	FL[b]	29	0.68	0.234	0.35	25	10.30	0.632	0.06
As	AA[c]	33	3.5	0.72	0.20	41	0.7	0.29	0.42
Se	AA	37	1.2	0.17	0.14	41	0.8	0.31	0.38
Al	PS[d]	30	96.0	17.6	0.18	30	350.0	21.4	0.06
B	PS	28	1,584.0	71.2	0.04	32	71.0	4.0	0.06
Ba	PS	28	139.0	5.2	0.04	32	32.0	1.4	0.04
Ca	PS	30	10,200.0	540.0	0.05	30	98,500.0	4,310.0	0.04
Co	PS	31	20.0	2.7	0.13	30	95.0	4.6	0.05
Cr	PS	26	95.0	6.0	0.06	34	19.0	3.6	0.19
Cu	PS	30	64.0	18.6	0.29	33	208.0	20.3	0.10
Fe	PS	31	86.0	21.7	0.25	30	984.0	49.5	0.05
K	PS	30	1,910.0	324.0	0.17	34	20,100.0	2,383.0	0.12
Li	PS	31	17.0	2.1	0.12	33	102.0	8.5	0.08
Mg	PS	28	9,300.0	390.0	0.04	30	72,400.0	3,160.0	0.04
Mn	PS	31	20.0	1.7	0.08	30	103.0	4.8	0.05
Mo	PS	28	34.0	7.2	0.21	33	6.0	5.7	0.90
Na	PS	30	1,600.0	220.0	0.14	33	44,800.0	3,780.0	0.08
Ni	PS	28	192.0	8.8	0.05	32	38.0	4.6	0.12
P	PS	31	109.0	21.2	0.19	34	4,790.0	404.2	0.08
Sc	PS	28	62.0	3.8	0.06	31	11.0	0.7	0.06
Si	PS	26	920.0	80.0	0.09	34	7,960.0	512.0	0.11
Sr	PS	30	54.43	3.702	0.07	30	5,155.77	170.646	0.03
Ti	PS	28	113.0	7.0	0.06	32	40.0	2.2	0.05
V	PS	26	10.0	3.0	0.27	30	41.0	5.0	0.12
Y	PS	31	9.0	1.1	0.12	32	47.0	2.0	0.04
Zn	PS	28	498.0	30.4	0.06	23	48.0	22.3	0.46

		Measurements Control Results for Stream Sediment							
		Batch R-3				Batch S-2			
Element	Method	No. of Samples	Mean (ppm)	Standard Deviation (ppm)	Coefficient of Variation	No. of Samples	Mean (ppm)	Standard Deviation (ppm)	Coefficient of Variation
U	FL	52	4.15	0.400	0.10	30	9.93	0.871	0.09
U	NT[e]	61	4.86	0.136	0.03	40	10.26	0.276	0.03
As	AA	38	3.6	0.53	0.15	24	9.8	0.98	0.10
Se	AA	40	0.4	0.24	0.53	27	0.8	0.28	0.36
Al	PS	53	31,900.0	2,450.0	0.08	32	55,800.0	4,470.0	0.08
B	PS	57	12.0	6.1	0.48	32	49.0	9.7	0.20
Ba	PS	50	416.0	16.1	0.04	35	381.0	20.3	0.05
Be	PS	56	1.0	2.3	1.64	35	2.0	0.6	0.27
Ca	PS	57	2,700.0	440.0	0.16	36	3,500.0	470.0	0.13
Ce	PS	49	62.86	10.815	0.17	32	83.19	22.161	0.27
Co	PS	55	13.0	2.3	0.17	34	22.0	4.1	0.18
Cr	PS	53	27.0	1.7	0.06	34	60.0	4.3	0.07
Cu	PS	53	21.0	2.7	0.13	33	45.0	2.9	0.06
Fe	PS	53	17,700.0	1,150.0	0.06	32	33,600.0	1,580.0	0.05
K	PS	53	9,800.0	810.0	0.08	30	19,400.0	1,580.0	0.08
Li	PS	55	22.0	1.5	0.07	34	34.0	3.4	0.10
Mg	PS	53	2,100.0	130.0	0.06	34	5,300.0	330.0	0.06
Mn	PS	53	1,898.0	112.4	0.06	32	761.0	38.4	0.05
Mo	PS	56	2.0	1.2	0.47	34	27.0	2.4	0.09
Na	PS	55	1,500.0	130.0	0.08	34	2,100.0	200.0	0.10
Nb	PS	57	12.0	3.8	0.31	35	10.0	5.3	0.50
Ni	PS	57	18.0	2.4	0.13	34	56.0	3.3	0.06
P	PS	53	1,808.0	251.0	0.14	32	808.0	88.3	0.11
Sc	PS	55	5.0	0.6	0.10	32	11.0	0.7	0.06
Sr	PS	51	54.39	2.899	0.05	35	79.94	5.693	0.07
Th	PS	57	7.0	4.3	0.60	36	8.0	2.6	0.32
Ti	PS	53	3,197.0	281.1	0.09	36	2,955.0	267.7	0.09
V	PS	53	52.0	4.6	0.09	30	157.0	10.7	0.07
Y	PS	55	19.0	1.6	0.08	34	28.0	1.4	0.05
Zn	PS	51	88.0	7.6	0.09	32	100.0	6.2	0.06
Zr	PS	51	131.0	8.9	0.07	32	112.0	5.9	0.05

(a) Mass spectrometry.
(b) Fluorometric analysis.
(c) Atomic absorption.
(d) Plasma source emission spectroscopy.
(e) Neutron activation delayed neutron count.

Figures A-1b and A-2b, respectively. A map of samples noted as having hydrogen sulfide odor at the time of sampling is presented in Figure 4. With the exception of four samples, all groundwater samples are from the Inyan Kara aquifer. Samples 405328, 409507, and 409520 were produced from the Sundance Formation and Sample 406438 was reported as being produced from the alluvium. The number of samples from each of the major geologic and lithologic units in the project area is presented in Table 3.

Observed data for the variables arsenic, calcium, magnesium, molybdenum, pH, selenium, specific conductance, sulfate, total alkalinity, vanadium, and uranium are listed in Table A-3. The figures in Appendix A present log frequency, lognormal probability, percentile, and areal symbol plots for arsenic, calcium, magnesium, molybdenum, pH, selenium, specific conductance, sulfate, total alkalinity, uranium, boron, lithium, potassium, sodium, strontium, uranium/specific conductance, and uranium/sulfate.

Uranium

Uranium concentrations in groundwater above the 84th percentile (7.35 ppb) are present in scattered clusters throughout the area sampled. The largest concentration of these clusters is in the northwest of the area sampled where uranium values above the 84th percentile are found in groundwaters from wells within and around the community of Dewey, south of Dewey along Beaver Creek in Custer and Fall River Counties, and southeast of Dewey at the Doran Ranch. A large cluster of uranium values occurs in the north central portion of the area sampled. These samples are from the groundwaters along Driftwood Creek and Driftwood Canyon approximately 4.8 km (3 mi) north to northwest of the town of Edgemont. The three highest uranium values for groundwater are located apart from the main body of groundwater samples in the southeastern section of the area sampled. They are from wells located at the Marty Ranch on the east side of Chilson Canyon and a spring located in Deadhorse Canyon. Two of these samples were taken from holding tanks in which large amounts of algae were noted. A final high uranium value is isolated in the far southeastern corner of the study area along the Cheyenne River. Some of the groundwaters which were high in uranium were taken from wells and springs located near old uranium mines. These include Samples 405089, 405311, 405356, 405357, 405379, 406468, and 409510. All of the preceding groundwaters are produced from the Inyan Kara Group. One uranium value greater than 84th percentile is from a well drilled into the Sundance Formation. It is located in the northern part of the survey area within the Black Hills National Forest.

The 16th percentile for uranium values in groundwater is below the detection limit of 0.20 ppb for uranium. The 25th percentile is 0.22 ppb for all uranium values. Most of the low uranium values are located in the central to south central section of the area sampled. These groundwaters are produced predominantly from the Inyan Kara Group. There are two probable reasons for low uranium values in a geologic unit which also

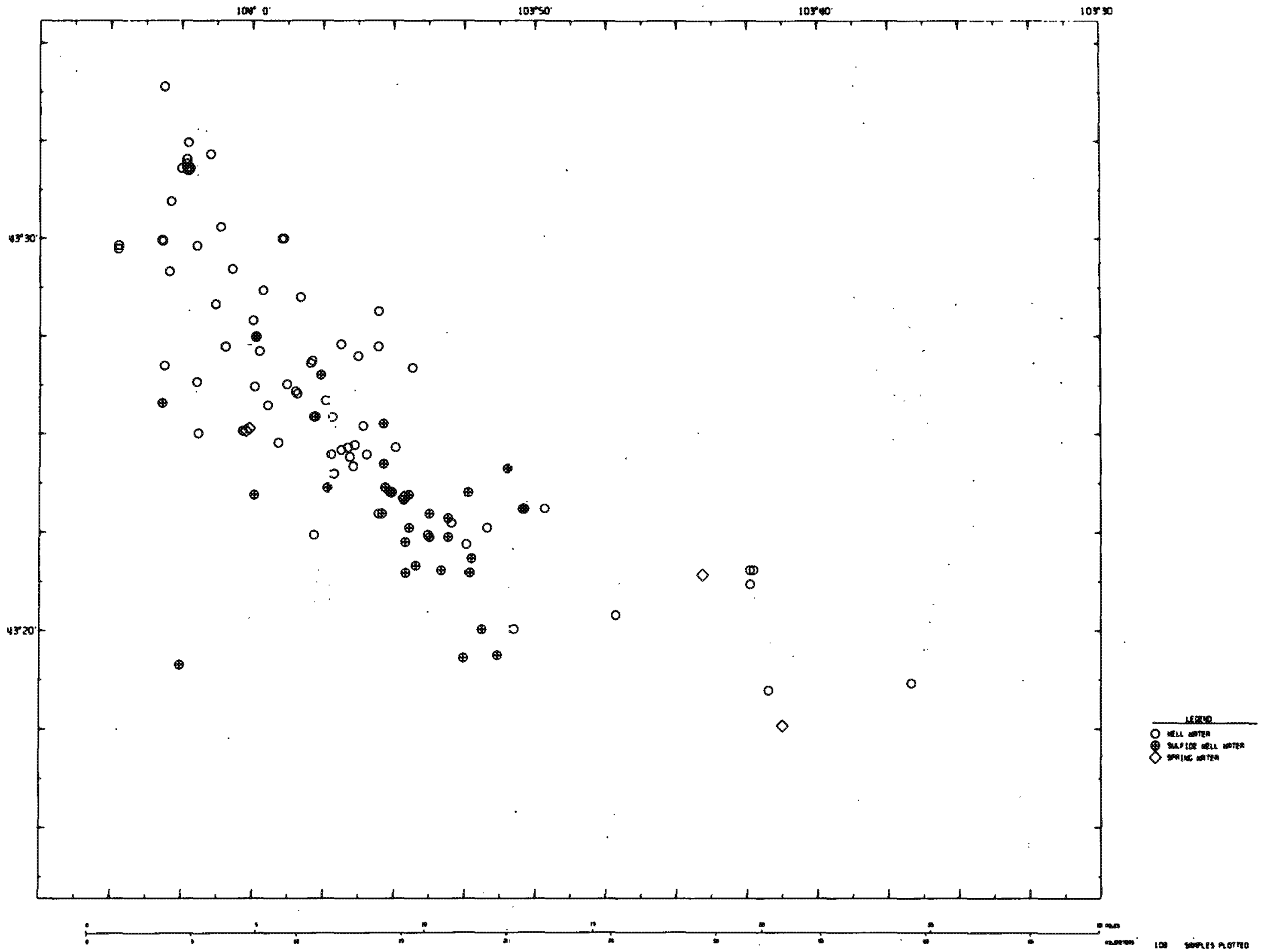

Figure 4

SULFIDE WELL LOCATION MAP FOR GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

Table 3

DISTRIBUTION OF SAMPLES BY GEOLOGIC UNIT
FROM THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

Geologic Unit	Geologic Unit Code	No. of Groundwater Samples	No. of Sediment Samples
Alluvium	QAL	1	34
Niobrara Marl and Carlile Shale	KNC	0	1
Greenhorn Limestone	KGCG	0	9
Graneros Group	KGDS	0	83
Inyan Kara Group	KFL	105	191
Unkpapa Sandstone and Morrison Formation	JMOR	0	7
Sundance Formation	JRSU	3	39
Spearfish Formation	TRSP	0	50
Minnekahta Limestone and Opeche Shale	PEMO	0	4
Minnelusa Formation	PMIN	0	1
Total		109	419

contains high uranium values in groundwater and deposits of uranium: (1) uranium has precipitated out of solution updip of the wells which are low in uranium and is not undergoing active leaching, and/or (2) a reducing environment is present which restricts the solubility of uranium in groundwater.

The correlation matrix (Table A-2) indicates a significant positive correlation coefficient of ≧0.25 for both Pearson and Spearman correlations between the logs of uranium, calcium, magnesium, potassium, strontium, uranium/specific conductance, and uranium/sulfate. There is a significant negative correlation between uranium, pH, and sodium.

Specific Conductance

The 84th percentile for specific conductance in the Edgemont project area is 3,014 µmhos/cm. Concentration of these high values for specific conductance are in two trends. One trend runs northeast-southwest from the Black Hills National Forest to south of the community of Burdock. Two of the high values in this trend are from the Sundance Formation and the others are produced from the Inyan Kara Group. The other trend is in the southern part of the project area and consists of scattered samples that run northeast-southwest from Chilson Canyon to south of the town of Edgemont. The greater than 84th percentile specific conductance values are from groundwaters of the Inyan Kara Group.

Geochemical plots for groundwater show associations of above 84th percentile values for specific conductance with calcium, lithium, magnesium, sodium, and sulfate. The correlation matrix indicates a significant positive correlation coefficient of ≧0.25 for both Pearson and Spearman correlations between the logs of specific conductance, calcium, potassium, magnesium, sodium, silicon, strontium, lithium, sulfate, and boron.

The 16th percentile for specific conductance is 1,319 µmhos/cm. The largest cluster of these "low" conductance values is between lat. 43°35' and 43°25' and roughly includes most of the groundwater samples taken along the Wyoming and South Dakota border eastward to the communities of Dewey and Burdock. These groundwaters produce from the Inyan Kara Group where it is overlain by the Graneros Group.

Related Variables

Three groups of variables are important for understanding the groundwater geochemistry and its relation to uranium in the Edgemont project area. The first group defines basic water types in the area and includes calcium, magnesium, pH, specific conductance, sulfate, and total alkalinity. High calcium and magnesium values form a trend in a northwestern to southeastern direction starting at lat. 43°30' along the northeastern edge of the sampled area. Sodium values above the 84th percentile (283.5 ppm) are located southwest of the high calcium and magnesium groundwaters. High sulfate values in groundwaters are located in two major trends running northeast to southwest. One is in the vicinity of the community of Burdock and the other is south of the town of Edgemont. The lowest values for sulfate are located directly west of Edgemont and correspond to the groundwater samples having the highest total alkalinity. Two of the groundwaters containing higher amounts of sulfate are produced from the Sundance Formation; all others are produced from the Inyan Kara Group. The groundwater geochemical plots for uranium, calcium, and sulfate show a good areal correspondence east of the Dewey Terrace. The strong negative correlation of sodium with uranium on the correlation matrix is confirmed by the geochemical plots.

The second group of elements considered are pathfinders for uranium sandstone deposits and include arsenic, molybdenum, and selenium. Although above 84th percentile values of these elements are not always in exact coincidence with above 84th percentile values for uranium or each other, in combination with uranium and one another they define areas of favorability. Observing the areal associations of these elements in the area sampled, one area of interest is directly west and northwest of the town of Edgemont near and within the Cheyenne River Valley. Here, a cluster of high uranium groundwaters also shows high values for molybdenum and in the southwest there is a cluster of groundwaters containing the highest values for arsenic and selenium in the project area. A smaller group of high molybdenum values is on the western side of this cluster. Groundwaters containing anomalous amounts of uranium near Dewey and along Beaver Creek on the Dewey Terrace are associated with high molybdenum values. There are several smaller areas with uranium and molybdenum in association. The high uranium groundwaters that are known to be near old uranium mine operations do not necessarily have areal associations with all of these pathfinder elements. Sample 405089, a groundwater sample taken on the Doran Ranch and near an inactive uranium mine, contains only a moderately high selenium value. This is also true for most of the other samples known to be taken near uranium mines.

The final group of variables to be considered are the sulfide well waters. The main body of sulfide water is located in the south central section of the sampled area west to northwest of the town of Edgemont. Sulfide is coincident with above 84th percentile values for uranium in some of the groundwaters sampled; however, most often they are associated with the very low to nondetectable values of uranium in groundwater west of Edgemont. Gott, et al (1974) considers sulfate reduction in groundwater as a major factor in the creation of an environment favorable to uranium precipitation. The interface between groundwaters containing high sulfate and sulfide groundwaters includes favorable areas.

Summary of Groundwater Data

Geochemical data for groundwaters in the Edgemont project area show two regions of separate character. They are easily divided by their specific conductance values. Well waters on the Dewey Terrace show overall lower specific conductance values than those to the south, along with lower values for calcium, magnesium, sulfate, and total alkalinity. Uranium values in these groundwaters as well as pathfinder elements are high and the area is shown to be distinct in geochemical plots for ratios of uranium/specific conductance and uranium/sulfate. The Inyan Kara Group overlain by the Graneros Group on the Dewey Terrace and to the southwest of the terrace appears to be favorable for uranium deposition. Uranium deposition here would probably be controlled by the Dewey Fault and Structural Zone.

Groundwater samples taken along the outcrop of the Inyan Kara Group are few. In many cases, they are near inoperative uranium mines. These groundwaters appear to reflect this with high values for uranium, occasional association with molybdenum, and consistent association with selenium.

The most interesting area geochemically is west of the town of Edgemont on the alluvial plain of the Cheyenne River. Here, very low uranium values are combined with above 84th percentiles for arsenic, molybdenum, and selenium waters low in sulfate, high in bicarbonate, and containing hydrogen sulfide. Updip are high uranium values and uranium mines.

The model of groundwater chemistry and its relation to uranium deposition proposed by Gott, et al (1974) is reflected in data collected by this project. Calcium sulfate waters appear to be confined to ares where the Inyan Kara is exposed at the surface and run in a northeast to southwest trend in the area sampled. Sodium sulfate waters are always downdip of these calcium sulfate waters. The most noticeable trend of sodium bicarbonate waters coincides with sulfide wells in the same area as mentioned in the preceding paragraph. The pH values however do not follow the exact model that Gott, et al (1974) noted for them. Calcium sulfate waters having high uranium values do not have higher pH values than other water samples. Data indicate that low pH values do exist in areas of sodium bicarbonate groundwaters with low uranium values indicating reducing conditions.

GEOCHEMICAL DISTRIBUTIONS IN STREAM SEDIMENTS

The sample site locations for stream sediments in the Edgemont detailed geochemical survey are shown on Plate 4. The symbol plot for the hot-acid-soluble uranium as determined by fluorometric analysis (U-FL) is presented on Plate 5 and in Figure B-1b. The symbol plot for thorium is presented on Plate 6 and in Figure B-4b. The number of stream sediment samples (419) which were collected from each of the major geologic and lithologic units of the survey area is presented in Table 3. Results from all stream sediment samples collected from the survey area are included in the microfiche in Appendix D.

Values for soluble uranium (U-FL), total uranium as determined by neutron activation (U-NT), thorium, arsenic, cobalt, copper, nickel, selenium, vanadium, zinc, and zirconium are listed in Table B-3. The figures in Appendix B present log frequency, lognormal probability, percentile, and areal symbol plots for the preceding variables plus U-FL/U-NT, aluminum, boron, calcium, cerium, chromium, iron, lithium, manganese, molybdenum, niobium, phosphorus, potassium, scandium, titanium, and yttrium.

Uranium

The areal distribution of uranium (Plate 5 and Figure B-1b) and U-NT (Figure B-2b) outlines four areas of uranium concentrations above the

84th percentile (5.50 ppm). In the northwestern corner of the sampled area, there are several sediment samples with uranium values above the 84th percentile. They are located near the community of Dewey, South Dakota and drain the immediate vicinity and to a small extent the western side of the Elk Mountains. The sediments are mostly from units of the Graneros Group. A trend of high uranium values that extends from near Pass Creek to Cheyenne and Dick Canyons is located in the southeast of the project area. These samples are primarily from basins draining formations of the Inyan Kara Group. From data provided by field personnel and information provided by the Tennessee Valley Authority on location of uranium mines, it appears that most of these samples are from basins draining open-pit uranium operations. The only exceptions to this are Samples 405643 and 405644 located on tributaries of Pass Creek. In the southeastern part of the survey area are two additional groups of samples with uranium values above the 84th percentile. Both clusters are located south of the Cheyenne River. One group drains the alluvium of the Cheyenne River and the Graneros Group immediately around the town of Edgemont. In the southwest of the project area, there is a cluster of high uranium values from basins draining the Graneros Group. Percentile plots for U-FL, U-NT, and U-FL/U-NT indicate that the Graneros Group contains high amounts of soluble uranium.

Less than 16th percentile (1.81 ppm) values for uranium are found in small clusters along the northern to northwestern boundary of the project area. These samples are from streams draining the Spearfish and Sundance Formations. A large cluster of uranium values below the 16th percentile are located in approximately the center of the sampled area east of the town of Burdock. These streams are in the Inyan Kara Group.

Geochemical and percentile plots for U-FL/U-NT indicate that all of the rock units within the sampled area contain high percentages of soluble uranium.

The correlation matrix (Table B-2) shows a significant positive correlation of ≧0.20 for both Pearson and Spearman correlations between the logs of U-FL, U-NT, aluminum, arsenic, cerium, chromium, cobalt, copper, iron, lithium, nickel, scandium, selenium, thorium, titanium, vanadium, yttrium, zinc, and zirconium. There is a negative correlation between U-FL and calcium.

Thorium

Geologic distribution of thorium in stream sediments is shown by the percentile plot (Figure B-4a). Values above the 84th percentile (9 ppm) are concentrated in units of the Inyan Kara Group; Graneros Group; the Niobrara, Carlile, and Greenhorn Formations; and the alluvium. These high values for thorium appear to be associated with greater than 84th percentile values for arsenic, barium, cobalt, copper, nickel, and zinc in samples from the Graneros Group. Best areal associations of greater than 84th percentile values for thorium in sediments from the Inyan Kara Group are with arsenic, iron, and titanium.

The correlation matrix (Table B-2) shows a significant positive correlation coefficient of ≥0.20 for both Pearson and Spearman correlations between the logs of thorium, U-FL, U-NT, aluminum, arsenic, boron, cerium, chromium, cobalt, copper, iron, lithium, manganese, nickel, niobium, phosphorus, potassium, scandium, titanium, vanadium, yttrium, zinc, and zirconium.

Related Variables

The correlation matrix shows positive associations between the log of the concentration of uranium and many other elements. Included among these are cerium, chromium, cobalt, copper, iron, nickel, scandium, yttrium, zinc, and zirconium. Areal plots indicate that most areas with stream sediment samples that have values greater than the 84th percentile for these elements which correspond with greater than 84th percentile values for uranium are in sediments of the Graneros Group. In most cases, percentile plots for these elements indicate the Graneros Group to have higher median values than the other rock units. In the northwestern section of the project area, where the Graneros Group crops out, the U-FL/U-NT values are moderate. Here, there is also a close areal association with thorium. These factors indicate an association of uranium with resistate minerals. In the southwest where the Graneros Group crops out, most of the same elements appear to be associated with uranium, the notable exceptions being a lesser amount of zirconium associated with uranium and the presence of phosphorus and barium. The U-FL/U-NT values are often above the 84th percentile and indicate a higher amount of soluble uranium in the southwest than in the northwest.

In the correlation matrix, arsenic, selenium, and vanadium are the most closely correlated with uranium. High uranium values in the Graneros Group correspond areally with above 84th percentile values for these three elements. However, median values are also generally higher in the Graneros Group for these elements than those of the other rock units. In the southwest, there is also a strong areal association between uranium and molybdenum.

In the Inyan Kara Group, there is an association of above 84th percentile values for molybdenum with above 84th percentile concentrations of uranium in the southern part of the survey area. Arsenic, selenium, and vanadium are also associated with high uranium values in the Inyan Kara Group.

Summary of Stream Sediment Data

Areal distribution and percentile plots for uranium in stream sediments indicate highest concentrations to be from basins draining the Graneros and Inyan Kara Groups. The ratio of U-FL/U-NT shows a high proportion of soluble uranium in the Graneros Group, with accompanying high concentrations of arsenic, selenium, and vanadium. There is also a positive association between uranium and a suite of elements that indicate the presence of resistate minerals. The anomalous uranium and pathfinder elements could possibly be associated with the bentonite beds contained in the Belle Fourche and Mowry Shales that are the dominant rock units cropping out in the southwestern part of the project area. The Skull Creek Shale is the dominant unit of the Graneros Group cropping out in the northwest and the different units outcropping are probably the reason for the different associations of elements with uranium in this area as compared to the southwest. As shown on the geochemical distribution plot, the high uranium values that are located in the Inyan Kara Group are almost exclusively draining open-pit uranium mines. The samples which are high in uranium also are high in the pathfinder elements arsenic, selenium, and vanadium.

Greater than 84th percentile concentrations of molybdenum are associated with above 84th percentile concentrations for uranium in the southern part of the area sampled in both the Graneros and Inyan Kara Groups.

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APPENDIX A

GROUNDWATER

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GROUNDWATER

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Table A-1

STATISTICAL SUMMARY FOR GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

	NO. OF SAMPLES ANALYZED										LN TRANSFORMATION			
													ROBUST	
ELEMENT	MEASURABLE VALUES	BELOW DETECTION LIMIT	DETECTION LIMIT	MINIMUM VALUE	MAXIMUM VALUE	MEAN	MEDIAN	MODE	STANDARD DEVIATION	COEFFICIENT OF VARIATION	MEAN	S. D.	MEAN	S. D.
U	86	23	<0.20	<0.20	109.10	6.24	0.51	<0.20	14.175	2.272	0.48	1.60	-0.32	2.06
SP	109			287	5892	2073	1771	1653	962.3	0.5	7.54	0.43	7.54	0.39
U/SP	109			0.02	27.58	2.43	0.30	0.07	4.876	2.009	-0.75	1.86	-0.78	1.76
U/B	109			0.11	368.37	42.28	6.77	1.32	77.945	1.844	1.95	2.17	1.95	2.29
U/SO	109			0.03	141.30	8.60	1.34	0.17	21.720	2.525	0.53	1.79	0.50	1.76
AG	22	87	<2	<2	6	2	<2	<2	1.2	0.4	0.95	0.36		
AL	37	72	<10	<10	339	41	<10	<10	61.0	1.5	3.27	0.82		
AS	83	26	<0.5	<0.5	53.7	4.0	0.8	<0.5	9.98	2.50	0.29	1.12	-0.24	1.90
B	109			32	931	215	96	42	230.0	1.1	4.85	1.01	4.82	0.93
BA	106	3	<2	<2	91	8	5	5	12.2	1.4	1.81	0.66	1.73	0.76
BE	1	108	<1	<1	1	1	<1	<1	0.0	0.0	0.0	0.0		
CA	109			1.0	505.3	106.0	51.4	5.6	121.59	1.15	3.80	1.57	3.86	1.64
CD	41	68	<2	<2	19	3	<2	<2	2.7	0.8	1.14	0.45		
CR	11	98	<4	<4	10	5	<4	<4	2.1	0.4	1.64	0.33		
CU	12	97	<2	<2	29	6	<2	<2	7.5	1.2	1.45	0.76		
FE	98	11	<10	<10	1044	35	23	25	103.3	2.9	3.20	0.49	3.11	0.42
K	109			1.7	28.7	10.0	8.5	7.1	5.61	0.56	2.15	0.57	2.16	0.56
LI	109			18	455	113	83	56	79.3	0.7	4.56	0.56	4.54	0.58
MG	109			0.8	279.4	42.6	19.0	2.5	53.22	1.25	3.00	1.32	3.01	1.26
MN	89	20	<2	<2	9566	213	32	2	1027.1	4.8	3.77	1.51	3.26	2.07
MO	49	60	<4	<4	25	8	<4	<4	4.2	0.5	2.06	0.42		
NA	109			8.6	744.1	204.7	210.1	211.9	104.30	0.51	5.15	0.67	5.20	0.63
NI	22	87	<4	<4	32	6	<4	<4	5.8	0.9	1.72	0.45		
P	2	107	<40	<40	985	520	<40	<40	656.9	1.3	5.46	2.03		
SC	11	98	<1	<1	1	1	<1	<1	0.0	0.0	0.0	0.0		
SE	109			0.2	8.7	0.8	0.5	0.4	1.08	1.42	-0.57	0.63	-0.63	0.55
SI	108	1	<0.1	<0.1	12.5	3.6	3.3	3.3	1.67	0.47	1.16	0.52	1.17	0.61
SR	109			51	10491	2285	1204	144	2587.8	1.1	7.01	1.33	7.04	1.29
TI	26	83	<2	<2	8	4	<2	<2	2.5	0.6	1.27	0.58		
V	23	86	<4	<4	15	5	<4	<4	2.8	0.5	1.68	0.38		
Y	30	79	<1	<1	2	1	<1	<1	0.3	0.2	0.05	0.18		
ZN	94	15	<4	<4	3193	92	9	6	384.8	4.2	2.80	1.30	2.31	1.66
ZR	13	96	<2	<2	6	3	<2	<2	1.5	0.5	1.06	0.42		
T-AK	109			35	920	261	179	165	192.0	0.7	5.37	0.61	5.36	0.65
M-AK	109			33	898	261	181	174	190.2	0.7	5.37	0.60	5.37	0.64
P-AK	109			0	90	6	0	0	13.5	2.1				
CL	65	44	<10	<10	501	48	13	<10	70.0	1.4	3.38	0.90		
NA/C	109			1.39	78.64	18.51	13.24	3.31	16.738	0.904	2.49	1.00	2.50	1.00
PH	109			6.2	9.1	7.7	7.7	8.1	0.58	0.03				
SO4	109			41	2910	731	542	506	560.5	0.8	6.27	0.90	6.31	0.93

NOTE: Refer to Table 1, Page 25 and Table C-1, Page C-4 for concentration units and symbol definitions.

Table A-2

CORRELATION MATRIX FOR GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

	L-U	LUSP	LUSO	L-NA	L-V	L-CA	L-MG	L-SR	L-K	PH	L-SI	L-SP
L-U	1.00 (86)											
LUSP	0.96*** 0.95*** (86)	1.00 (109)										
LUSO	0.87*** 0.83*** (86)	0.93*** 0.90*** (109)	1.00 (109)									
L-NA	-0.48*** -0.48*** (86)	-0.63*** -0.61*** (109)	-0.58*** -0.46*** (109)	1.00 (109)								
L-V	0.50** 0.55** (15)	0.61*** 0.52** (23)	0.55*** 0.40* (23)	-0.64*** -0.47** (23)	1.00 (23)							
L-CA	0.54*** 0.54*** (86)	0.43*** 0.42*** (109)	0.16* 0.17* (109)	-0.48*** -0.57*** (109)	0.33 0.26 (23)	1.00 (109)						
L-MG	0.52*** 0.52*** (86)	0.38*** 0.39*** (109)	0.16* 0.15 (109)	-0.42*** -0.51*** (109)	0.30 0.30 (23)	0.95*** 0.98*** (109)	1.00 (109)					
L-SR	0.44*** 0.43*** (86)	0.32*** 0.33*** (109)	0.07 0.07 (109)	-0.29*** -0.39*** (109)	0.13 0.14 (23)	0.93*** 0.93*** (109)	0.93*** 0.94*** (109)	1.00 (109)				
L-K	0.29*** 0.29*** (86)	0.26*** 0.28*** (109)	0.04 0.02 (109)	-0.34*** -0.53*** (109)	0.24 0.19 (23)	0.81*** 0.81*** (109)	0.85*** 0.84*** (109)	0.83*** 0.82*** (109)	1.00 (109)			
PH	-0.42*** -0.45*** (86)	-0.42*** -0.42*** (109)	-0.34*** -0.32*** (109)	0.47*** 0.45*** (109)	-0.54*** -0.36* (23)	-0.61*** -0.66*** (109)	-0.65*** -0.66*** (109)	-0.60*** -0.62*** (109)	-0.47*** -0.54*** (109)	1.00 (109)		
L-SI	0.17 0.13 (85)	0.07 0.06 (108)	0.10 0.06 (108)	-0.17* 0.00 (108)	0.42** 0.08 (23)	0.20** 0.33*** (108)	0.22** 0.31*** (108)	0.21** 0.31*** (108)	0.09 0.11 (108)	-0.23** -0.19** (108)	1.00 (108)	
L-SP	0.13 0.08 (86)	-0.20** -0.21** (109)	-0.30*** -0.25*** (109)	0.34*** 0.30*** (109)	-0.49** -0.22 (23)	0.39*** 0.43*** (109)	0.51*** 0.49*** (109)	0.54*** 0.52*** (109)	0.35*** 0.34*** (109)	-0.16* -0.18* (109)	0.20*** [illegible] (108)	1.00 (109)
L-LI	0.11 0.09 (86)	-0.08 -0.06 (109)	-0.25*** -0.23** (109)	0.16* 0.08 (109)	-0.13 -0.01 (23)	0.55*** 0.58*** (109)	0.62*** 0.60*** (109)	0.63*** 0.66*** (109)	0.52*** 0.53*** (109)	-0.20** -0.26*** (109)	0.25*** 0.35*** (108)	0.72*** 0.72*** (109)
LSO4	0.28*** 0.26** (86)	0.12 0.09 (109)	-0.22** -0.21** (109)	0.02 -0.08 (109)	-0.06 -0.05 (23)	0.70*** 0.72*** (109)	0.72*** 0.72*** (109)	0.79*** 0.76*** (109)	0.63*** 0.63*** (109)	-0.27*** -0.26*** (109)	0.09 0.29*** (108)	0.66*** 0.76*** (109)
L-MO	0.06 -0.33 (37)	-0.11 -0.15 (49)	-0.15 -0.15 (49)	0.24* 0.21 (49)	-0.36* -0.37* (11)	0.13 0.01 (49)	0.15 0.04 (49)	0.10 0.06 (49)	0.04 -0.01 (49)	-0.07 -0.03 (49)	-0.05 0.11 (49)	0.21 0.06 (49)
L-CO	-0.08 -0.33 (30)	0.04 0.04 (41)	-0.00 0.03 (41)	-0.28* -0.28* (41)	0.25 0.22 (15)	0.18 0.14 (41)	0.22 0.13 (41)	0.06 0.01 (41)	0.16 0.06 (41)	-0.17 -0.17 (41)	-0.05 0.05 (41)	-0.06 0.02 (41)
L-MN	-0.20* -0.09 (74)	-0.12 -0.04 (89)	-0.21* -0.12 (89)	-0.05 -0.12 (89)	-0.03 0.06 (17)	0.35*** 0.35*** (89)	0.36*** 0.35*** (89)	0.32*** 0.35*** (89)	0.31*** 0.30*** (89)	-0.20* -0.22** (89)	-0.26*** -0.22** (88)	0.21* 0.14 (89)
L-ZN	0.11 0.35 (73)	0.01 -0.11 (94)	-0.05 -0.09 (94)	-0.25** -0.05 (94)	0.44** -0.10 (21)	0.25** 0.20* (94)	0.29*** 0.23** (94)	0.22** 0.13 (94)	0.22** 0.11 (94)	-0.19* -0.01 (94)	-0.02 -0.00 (93)	0.13 0.36*** (94)
LTAK	-0.13 -0.17 (86)	-0.24** -0.28*** (109)	0.02 -0.01 (109)	0.31*** 0.35*** (109)	-0.35 -0.29 (23)	-0.57*** -0.37*** (109)	-0.37*** -0.28*** (109)	-0.42*** -0.29*** (109)	[illegible] -0.19* (109)	0.11 0.13 (109)	0.11* 0.01 (108)	0.16* 0.24** (109)
L-CL	-0.19 -0.26* (46)	-0.29** -0.30** (65)	0.04 0.10 (65)	0.42*** 0.36*** (65)	-0.44* -0.40* (16)	-0.57*** -0.51*** (65)	-0.36*** -0.42*** (65)	-0.47*** -0.48*** (65)	-0.49*** -0.51*** (65)	0.17 0.08 (65)	0.10 0.15 (65)	0.15 0.16 (65)
L-B	0.00 -0.00 (86)	-0.22** -0.23** (109)	-0.08 -0.03 (109)	0.21** 0.25*** (109)	-0.36* -0.36* (23)	-0.13 0.06 (109)	0.05 0.11 (109)	-0.02 0.07 (109)	-0.12 -0.05 (109)	-0.01 0.10 (109)	0.42*** 0.44*** (108)	0.54*** 0.55*** (109)
L-BA	0.34 0.05 (84)	0.02 -0.02 (106)	0.22** 0.19* (106)	-0.10 -0.04 (106)	0.04 -0.01 (23)	-0.24** -0.05 (106)	-0.13 -0.04 (106)	-0.26*** -0.13 (106)	-0.22** -0.16* (106)	-0.01 -0.05 (106)	0.33*** 0.29*** (105)	-0.05 0.13 (106)
L-SE	0.32*** 0.17 (86)	0.10 -0.02 (109)	0.24** 0.16* (109)	-0.15 0.04 (109)	-0.13 -0.04 (23)	-0.06 -0.03 (109)	0.05 0.01 (109)	0.00 -0.01 (109)	-0.01 -0.04 (109)	-0.17* -0.12 (109)	0.26*** 0.22** (108)	0.16 0.27*** (109)
L-AL	-0.23 -0.09 (27)	-0.16 -0.12 (37)	0.04 0.05 (37)	-0.02 -0.05 (37)	-0.18* -0.08* (8)	-0.30* -0.01 (37)	-0.18 0.02 (37)	-0.27 -0.09 (37)	-0.24 -0.02 (37)	-0.11 -0.26* (37)	0.00 0.10 (36)	0.01 0.21 (37)
L-AS	-0.28** -0.22* (67)	-0.20* -0.17 (83)	-0.01 -0.00 (83)	0.21* 0.37*** (83)	0.13 0.12 (17)	-0.56*** -0.36*** (83)	-0.39*** -0.31*** (83)	-0.47*** -0.35*** (83)	-0.55*** -0.41*** (83)	0.12 0.14 (83)	0.13 0.11 (82)	-0.00 0.13 (83)

NOTE: (1) Pearson correlation/Spearman correlation/(sample size). If either element has a concentration below the laboratory detection limits, it is omitted from the pairwise computations.
(2) Significance levels: *-10%, **-5%, ***-1%.

	L-LI	LSO4	L-MG	L-CU	L-MN	L-ZN	LTAK	L-CL	L-B	L-BA	L-SE	L-AL	L-AS
L-LI	1.00 (109)												
LSO4	0.71*** 0.71*** (109)	1.00 (109)											
L-MG	0.32** 0.31** (49)	0.18 0.04 (49)	1.00 (49)										
L-CU	0.08 0.01 (41)	0.05 0.02 (41)	-0.03 0.12 (15)	1.00 (41)									
L-MN	0.19* 0.18* (89)	0.37*** 0.26** (89)	0.05 0.11 (42)	0.59*** 0.32* (28)	1.00 (89)								
L-ZN	0.17* 0.28*** (94)	0.16* 0.24** (94)	0.06 0.05 (42)	0.30** 0.18 (37)	0.29** 0.08 (73)	1.00 (94)							
LTAK	-0.15 -0.11 (109)	-0.40*** -0.25** (109)	-0.07 -0.21 (49)	-0.14 -0.04 (41)	-0.26** -0.11 (89)	-0.18* 0.04 (94)	1.00 (109)						
L-CL	-0.19 -0.19 (65)	-0.56*** -0.44*** (65)	0.01 -0.09 (31)	-0.06 -0.01 (20)	-0.38*** -0.24 (48)	-0.00 0.29** (60)	0.77*** 0.69*** (65)	1.00 (65)					
L-B	0.35*** 0.30*** (109)	-0.05 0.06 (109)	0.26* 0.20 (49)	0.01 0.04 (41)	-0.10 -0.05 (89)	0.03 0.26** (94)	0.50*** 0.39*** (109)	0.70*** 0.72*** (65)	1.00 (109)				
L-BA	-0.15 -0.02 (106)	-0.43*** -0.21** (106)	-0.07 0.02 (48)	0.27* 0.35** (39)	-0.26** -0.07 (87)	0.14 0.38*** (92)	0.39*** 0.25*** (106)	0.59*** 0.58*** (64)	0.48*** 0.56*** (106)	1.00 (106)			
L-SE	0.00 0.02 (109)	-0.19** -0.07 (109)	-0.18 -0.10 (49)	-0.16 -0.16 (41)	-0.23** -0.15 (89)	0.02 0.17* (94)	0.44*** 0.58*** (109)	0.46*** 0.55*** (65)	0.32*** 0.45*** (109)	0.31*** 0.43*** (106)	1.00 (109)		
L-AL	-0.38 0.13 (37)	-0.33** -0.00 (37)	0.05 0.01 (18)	0.17 0.22 (20)	0.45** 0.31 (27)	0.09 0.13 (35)	0.34** 0.14 (37)	0.34* 0.30 (27)	0.33** 0.31* (37)	0.32* 0.27 (35)	0.14 0.23 (37)	1.00 (37)	
L-AS	-0.16 -0.37 (83)	-0.43*** -0.31*** (83)	0.06 0.01 (36)	0.18 0.14 (26)	-0.06 -0.05 (67)	-0.01 0.11 (69)	0.55*** 0.25** (63)	0.51*** 0.26** (52)	0.44*** 0.05 (83)	0.31*** 0.22** (81)	0.12 0.01 (83)	0.56*** 0.33 (21)	1.00 (83)

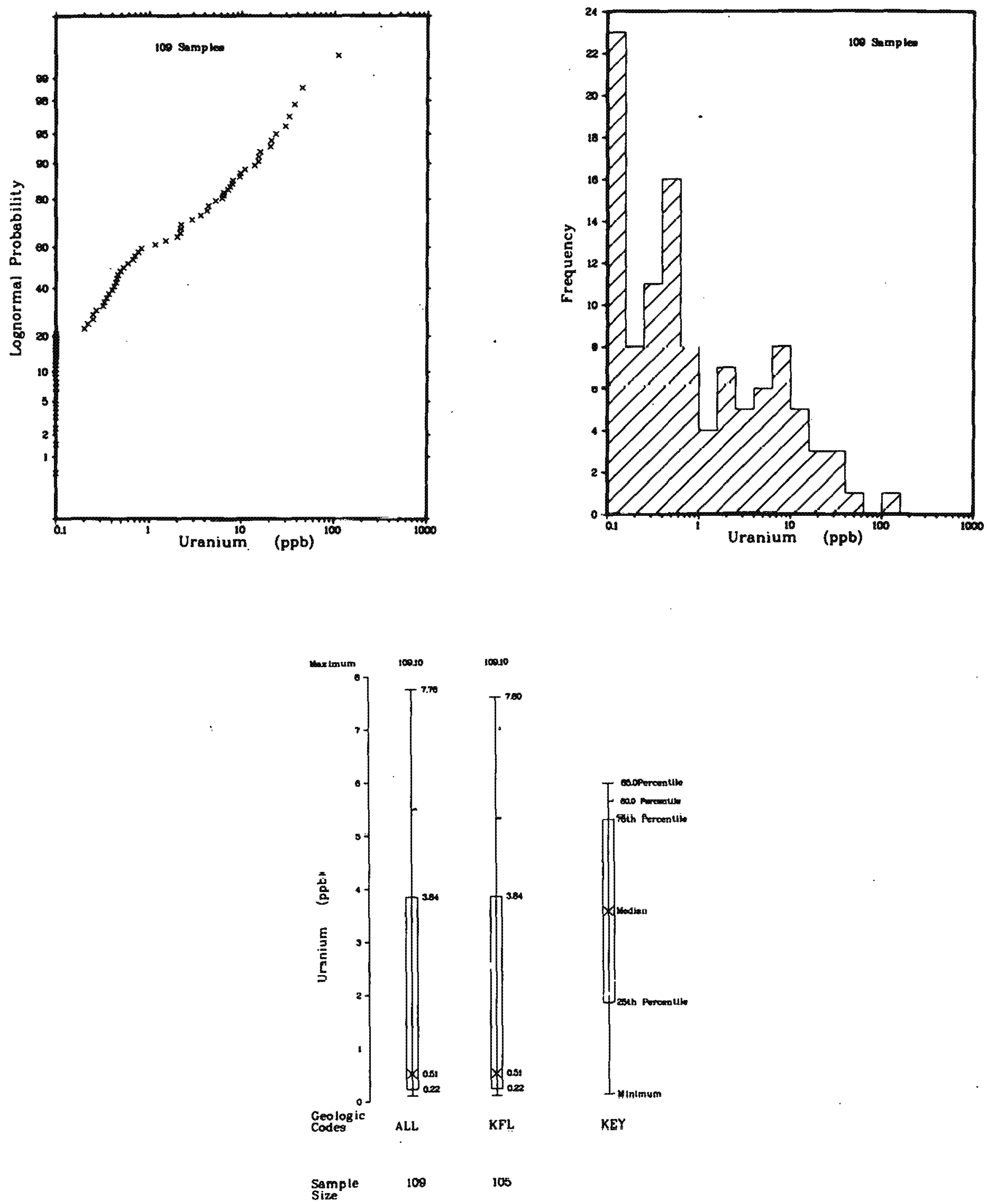
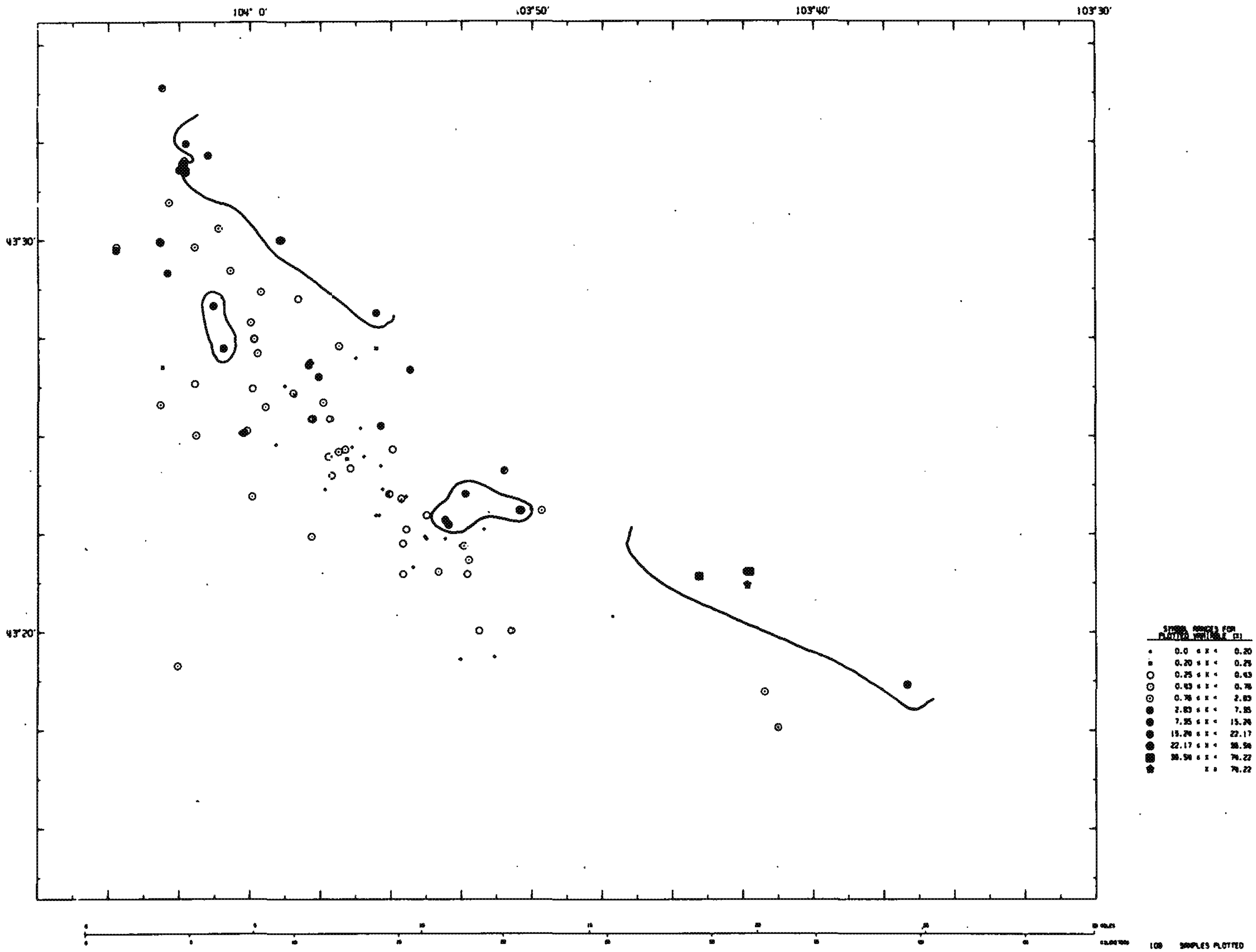


Figure A-1a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR URANIUM (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤7.35 ppb

Figure A-1b

GEOCHEMICAL DISTRIBUTION OF URANIUM (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

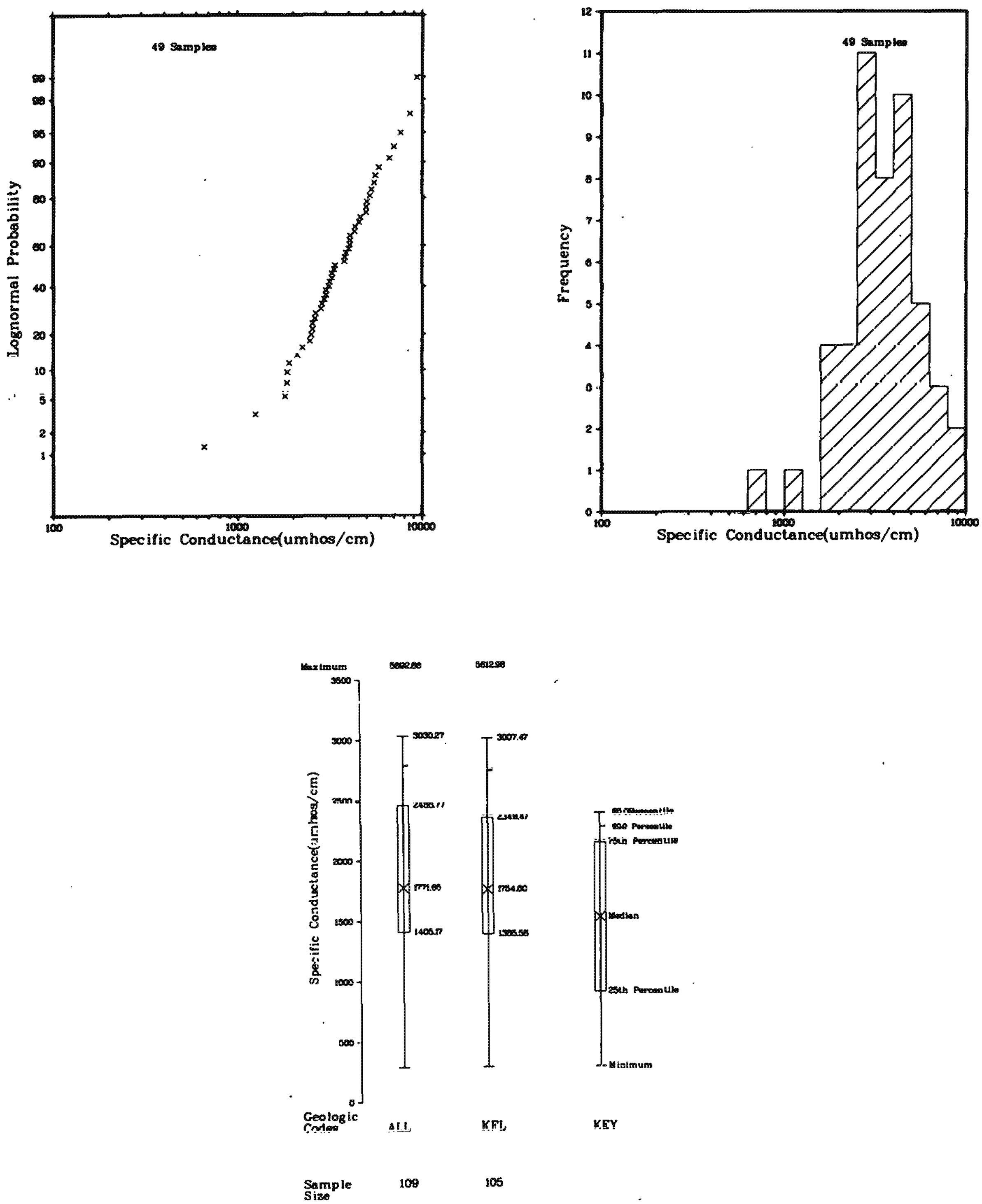
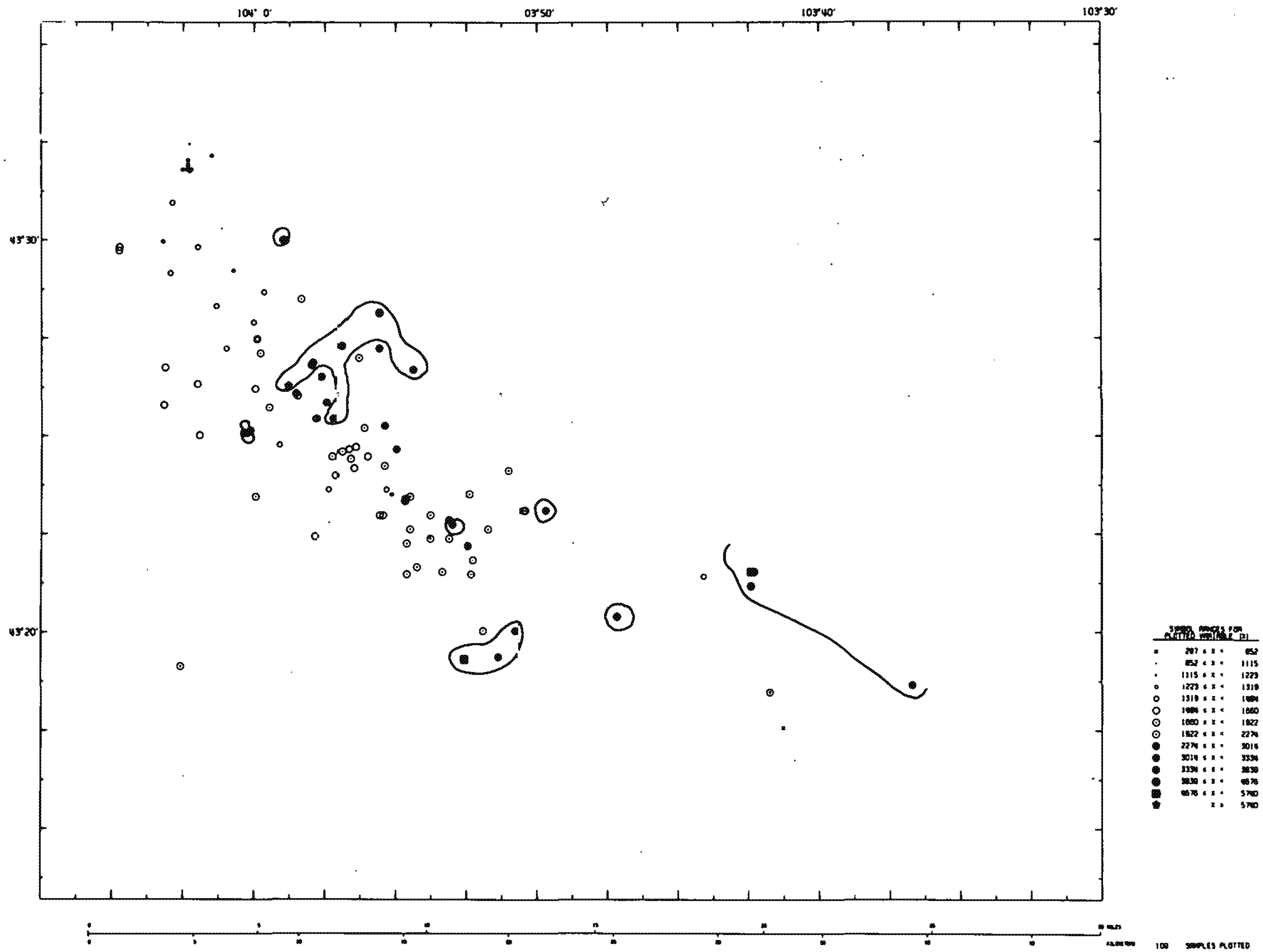


Figure A-2a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SPECIFIC CONDUCTANCE (µMHOS/CM) IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤3,014 μmhos/cm

Figure A-2b

GEOCHEMICAL DISTRIBUTION OF SPECIFIC CONDUCTANCE (μMHOS/CM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

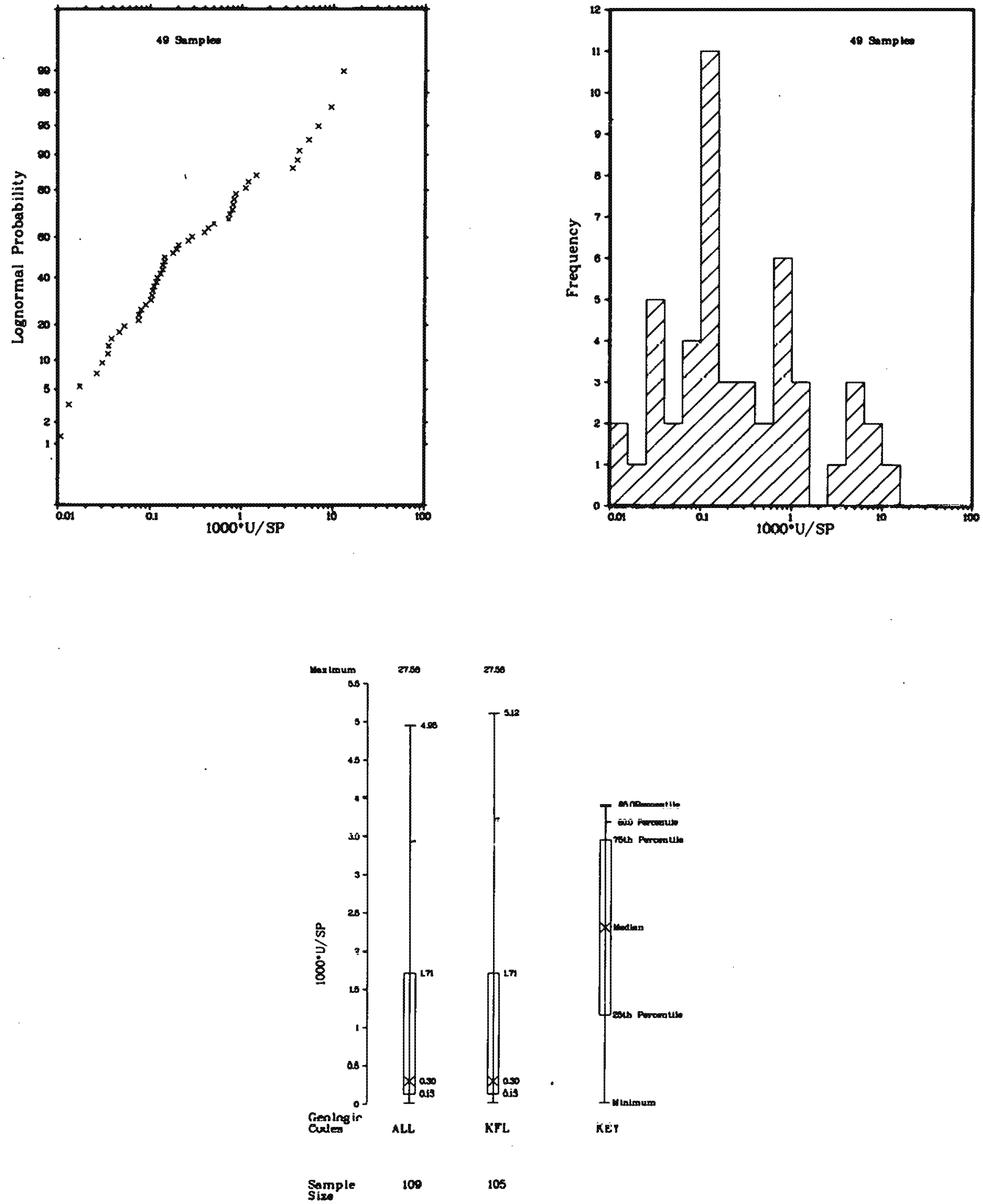
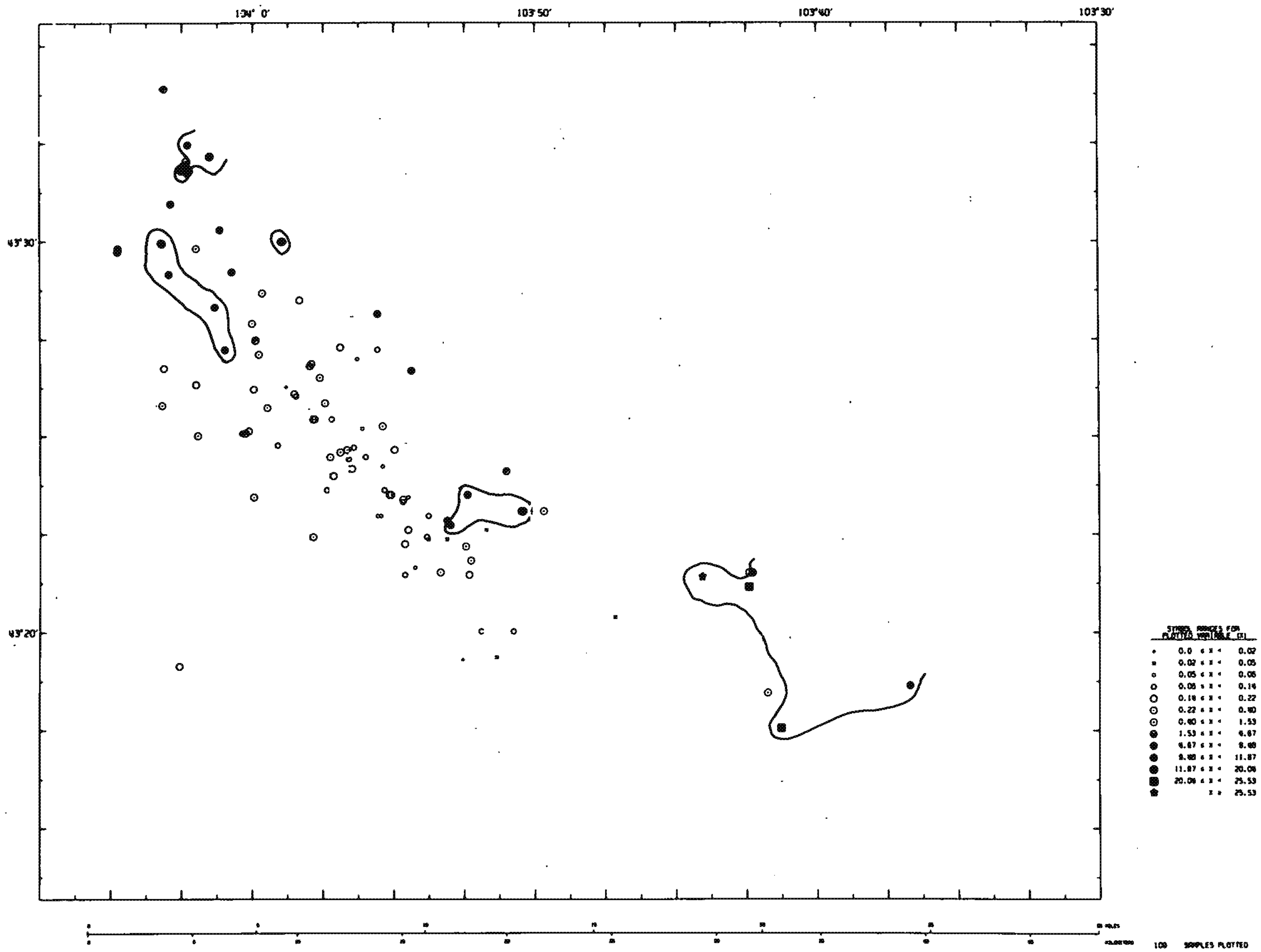


Figure A-3a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR 1,000·URANIUM/SPECIFIC CONDUCTANCE IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤4.67

Figure A-3b

GEOCHEMICAL DISTRIBUTION OF 1,000·URANIUM/SPECIFIC CONDUCTANCE IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

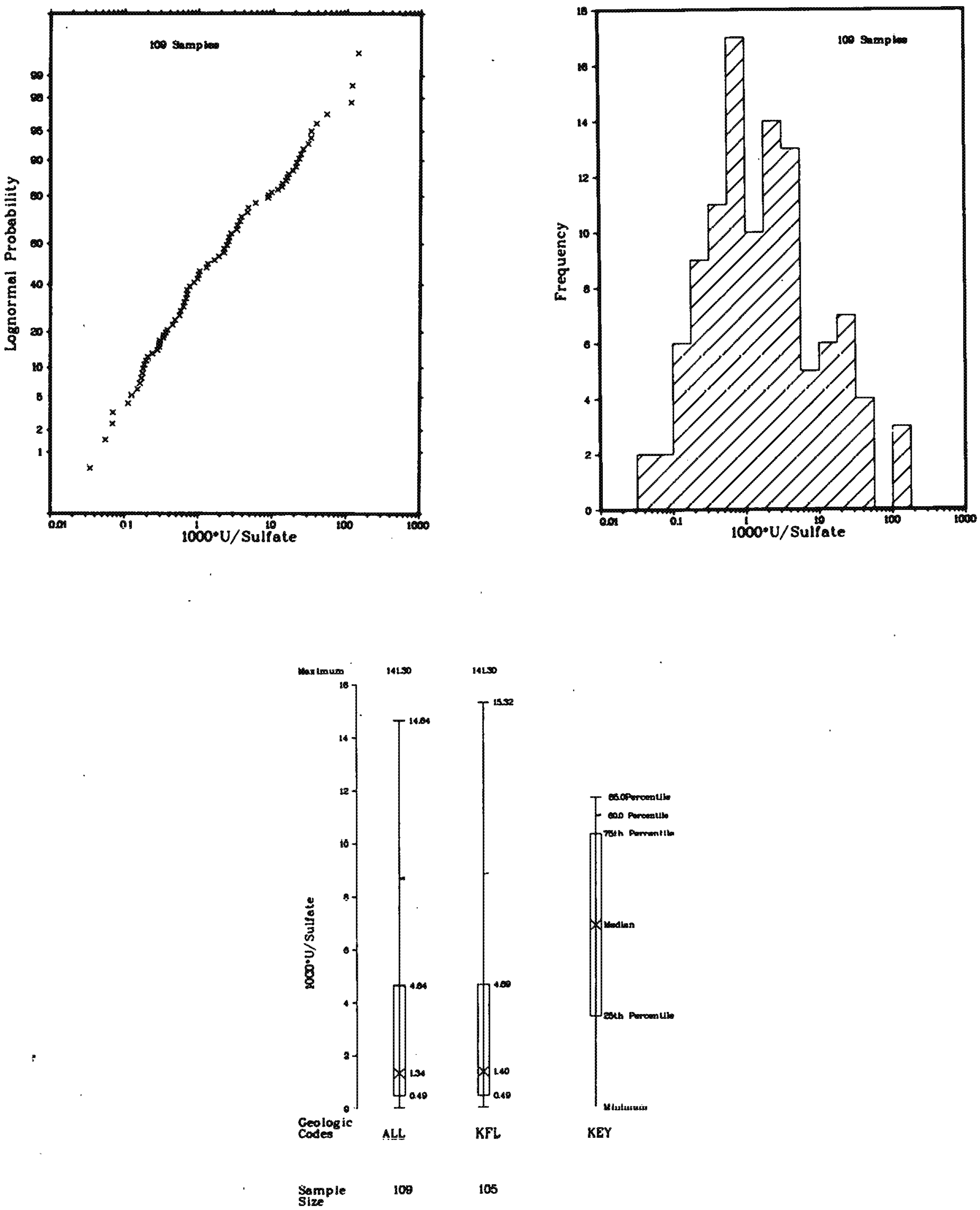
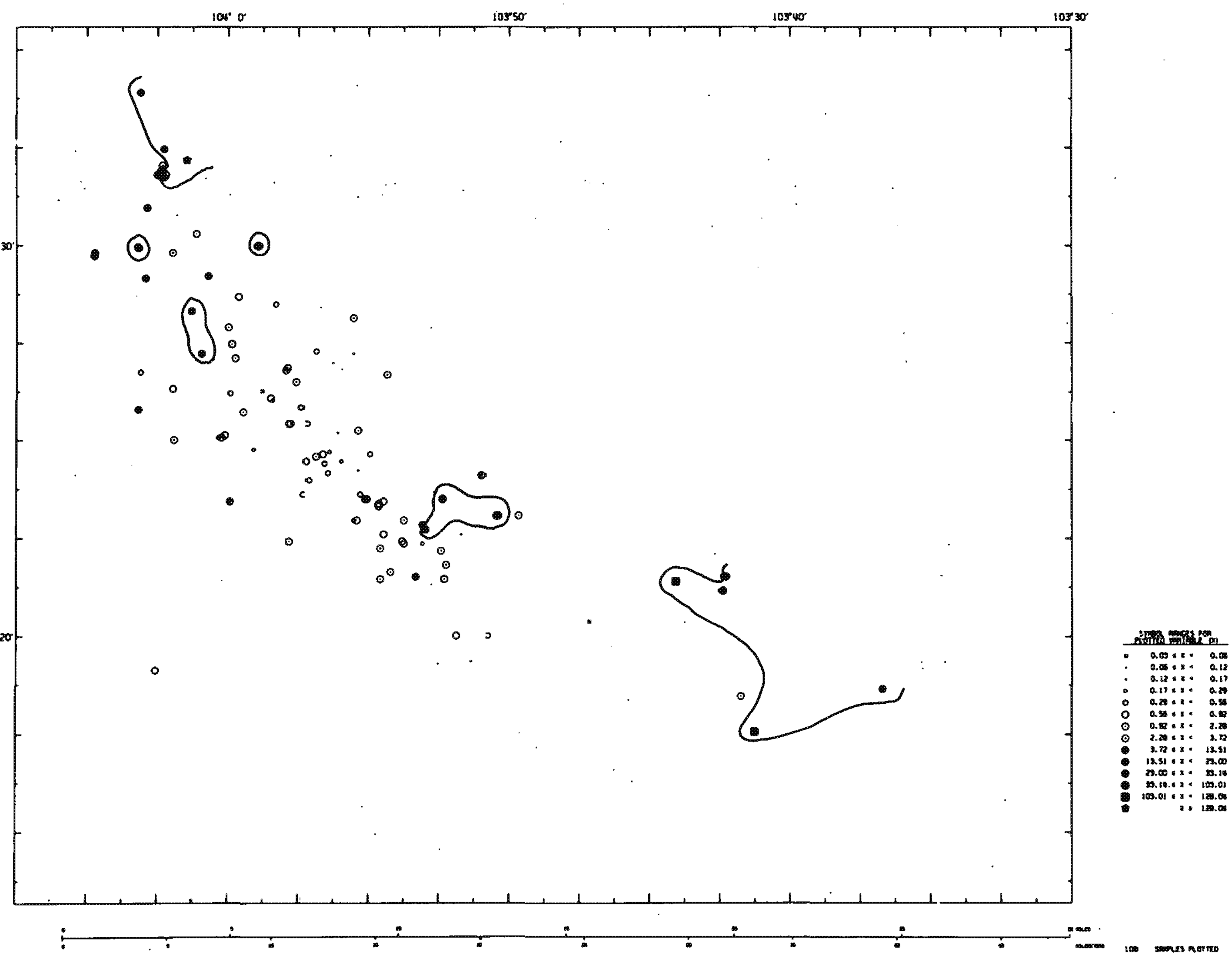


Figure A-4a

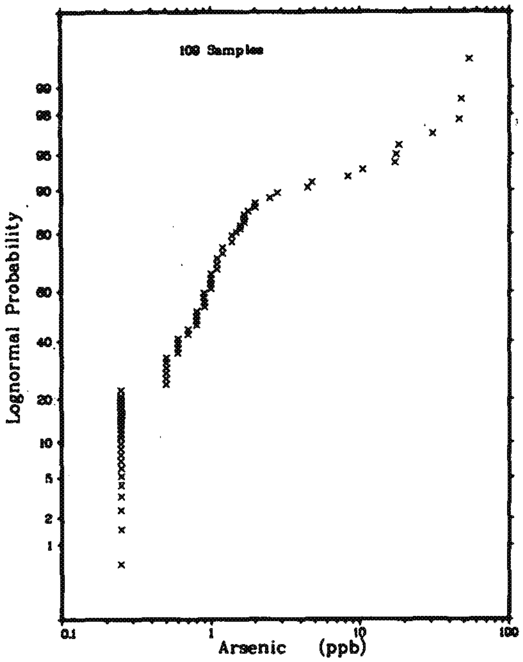
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR 1,000·URANIUM/SULFATE
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

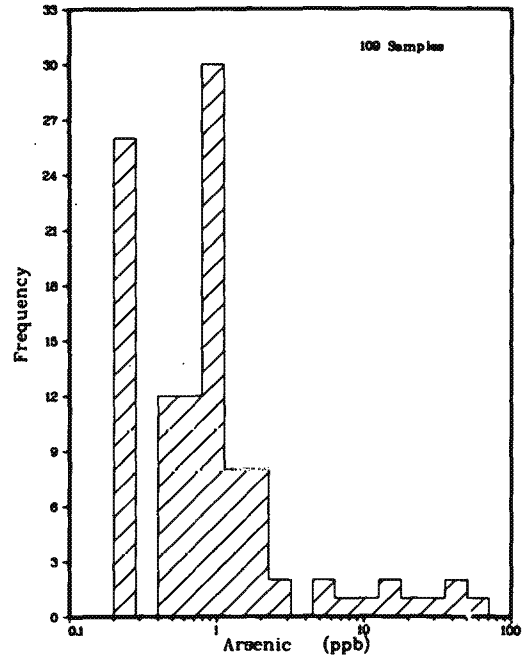


Approximate
Contour
≤13.51

Figure A-4b

GEOCHEMICAL DISTRIBUTION OF 1,000·URANIUM/SULFATE IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





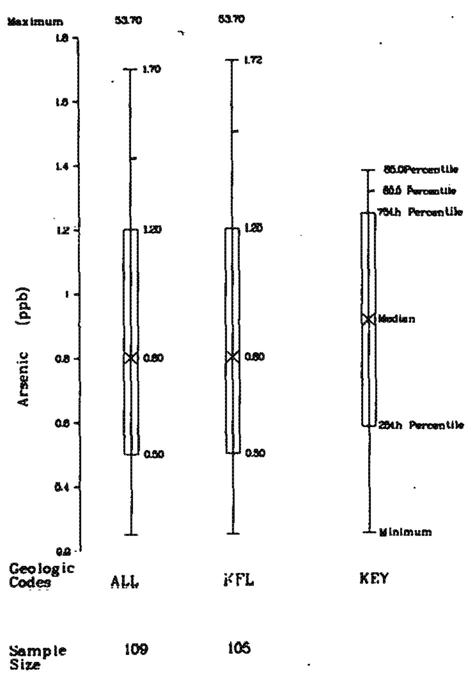
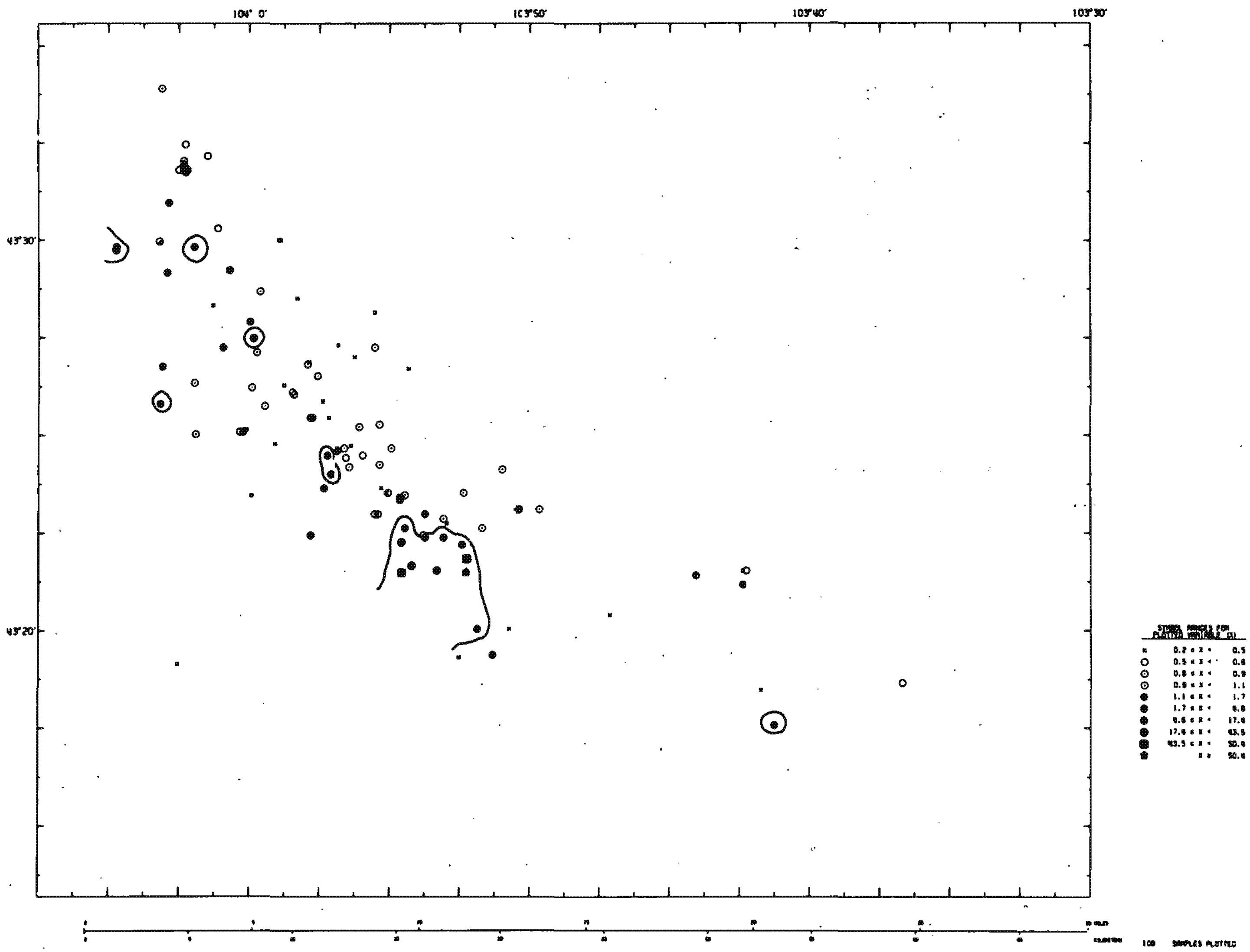


Figure A-5a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ARSENIC (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤1.7 ppb

Figure A-5b

GEOCHEMICAL DISTRIBUTION OF ARSENIC (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

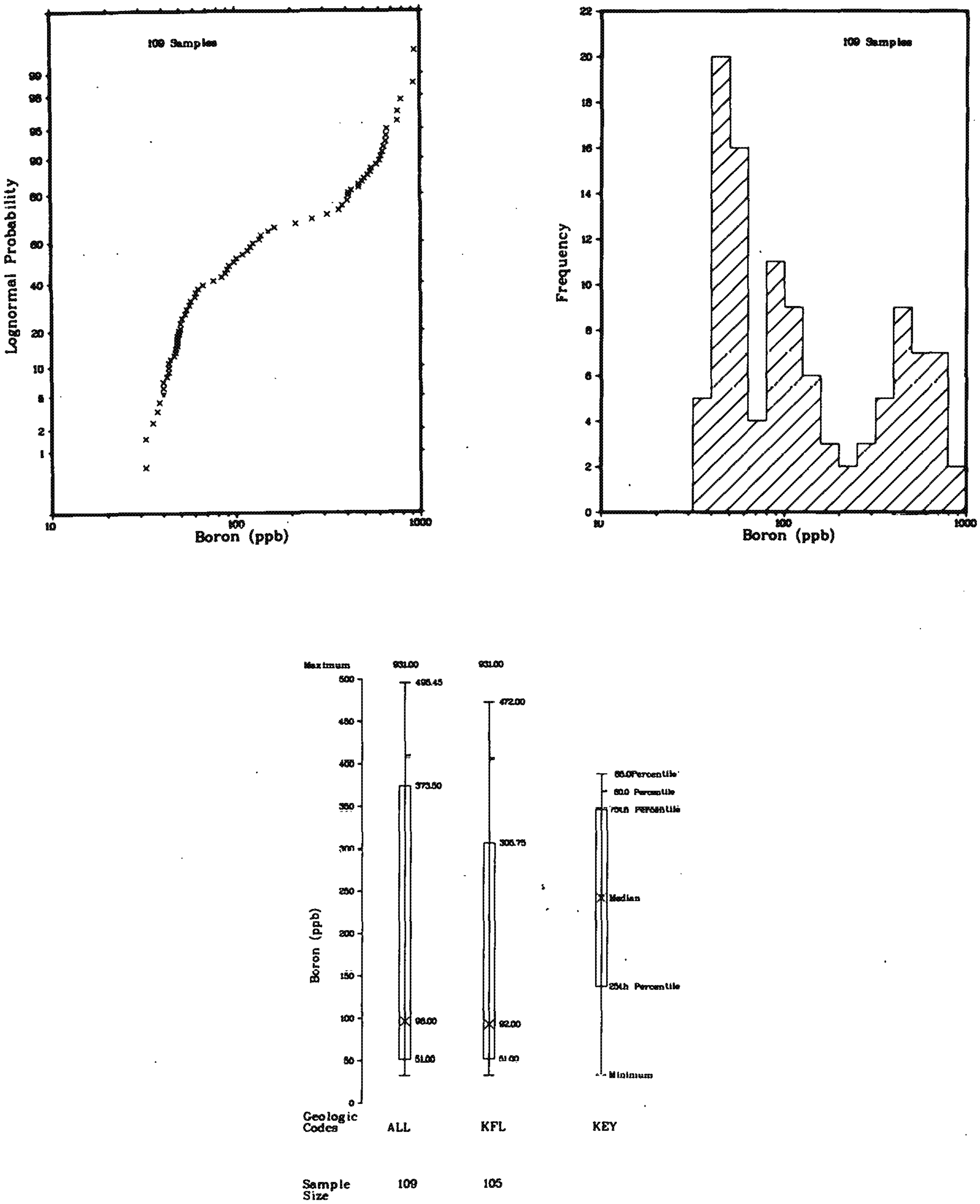
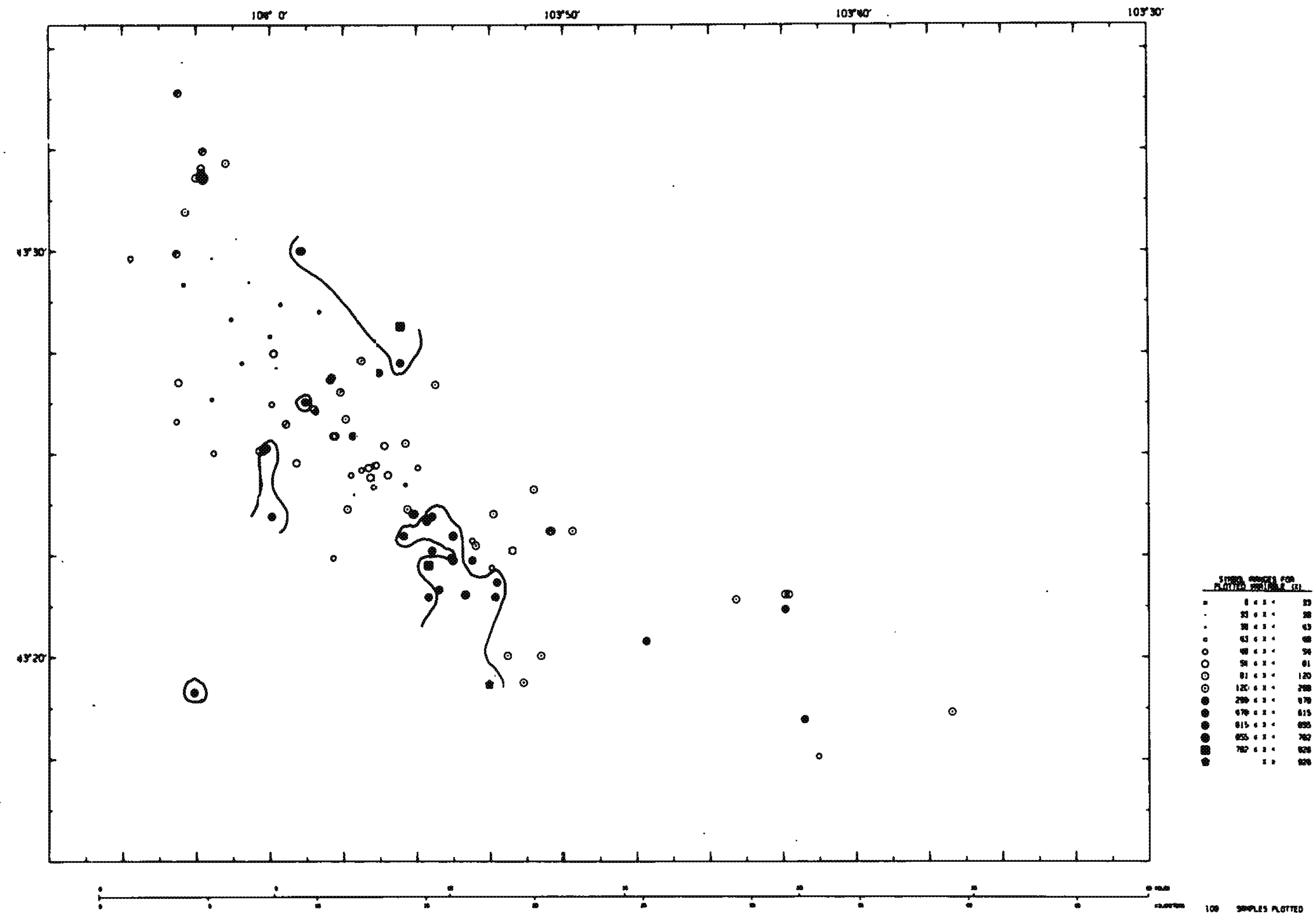


Figure A-6a

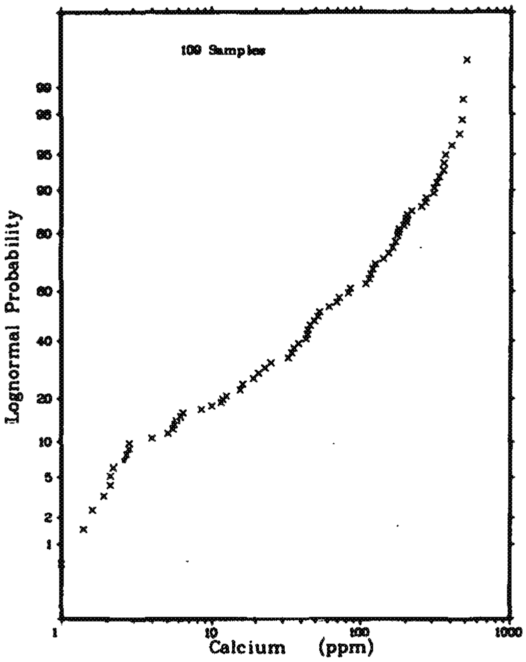
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR BORON (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

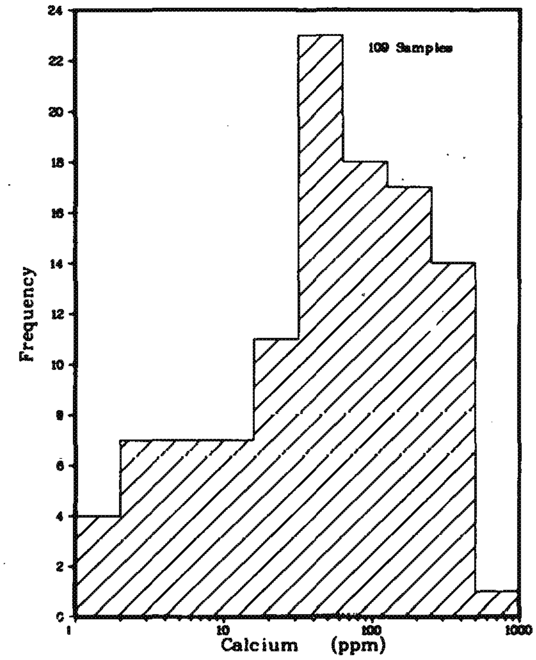


Approximate
Contour
≤478 ppb

Figure A-6b

GEOCHEMICAL DISTRIBUTION OF BORON (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





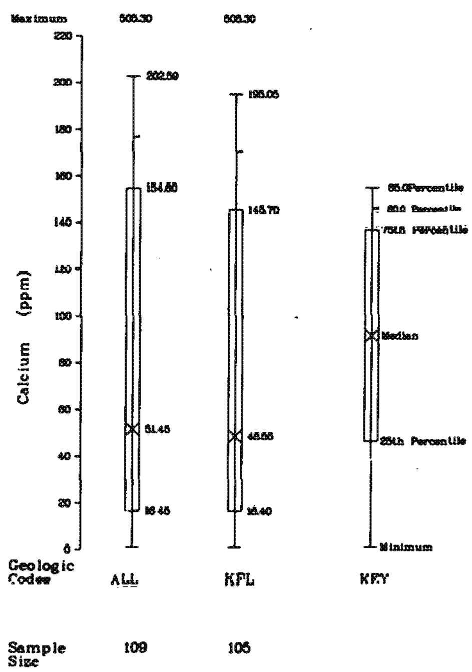
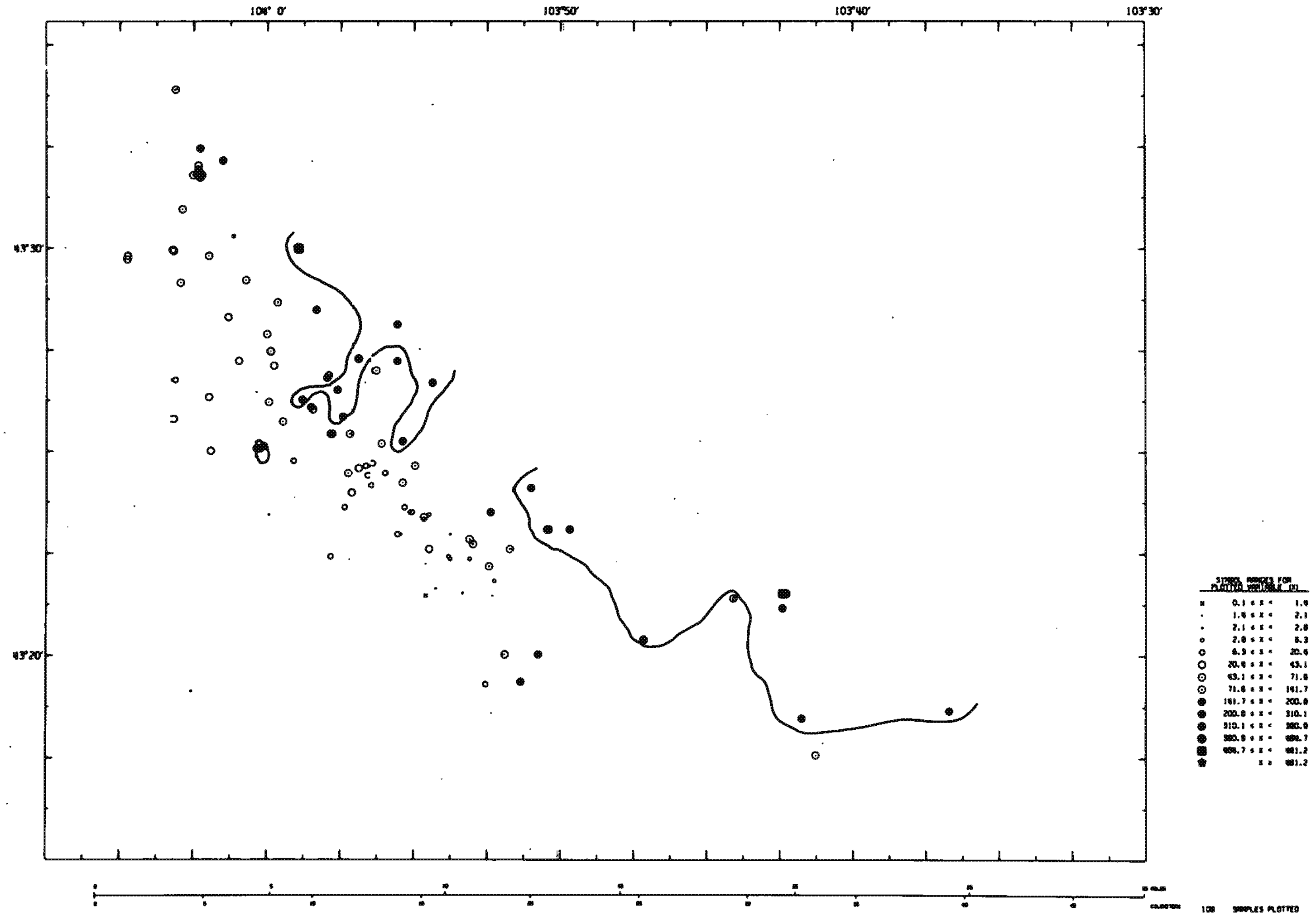


Figure A-7a

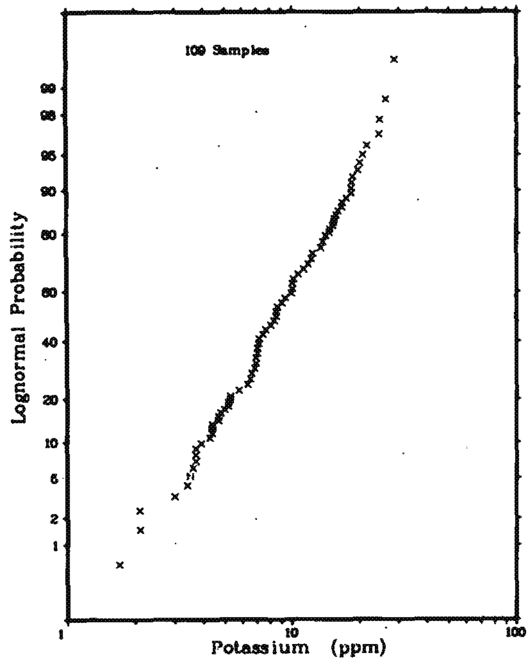
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR CALCIUM (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

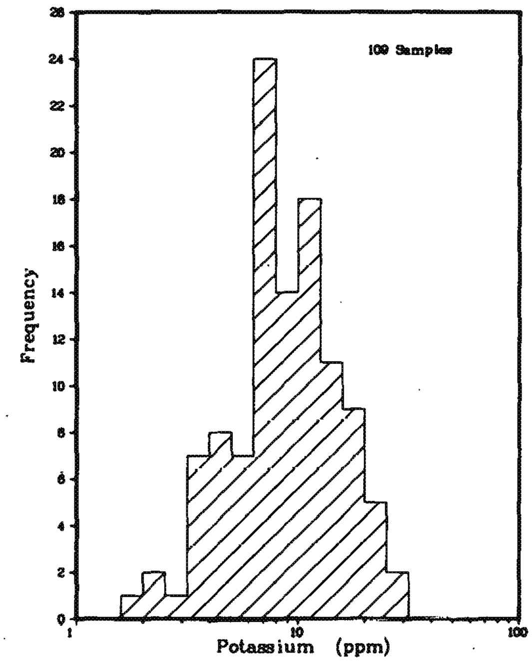


Approximate
Contour
≤200.8 ppm

Figure A-7b

GEOCHEMICAL DISTRIBUTION OF CALCIUM (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





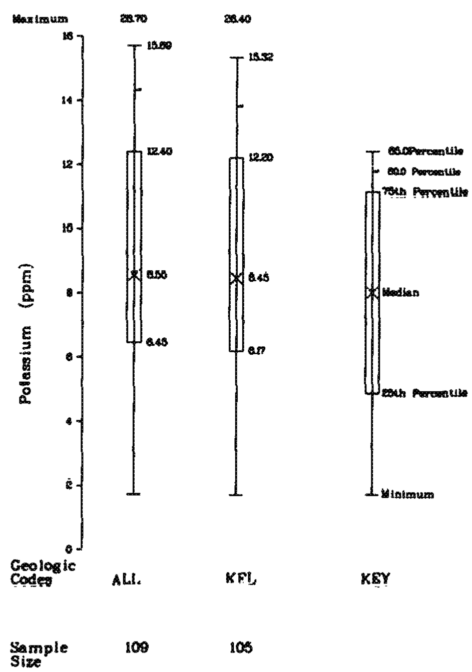
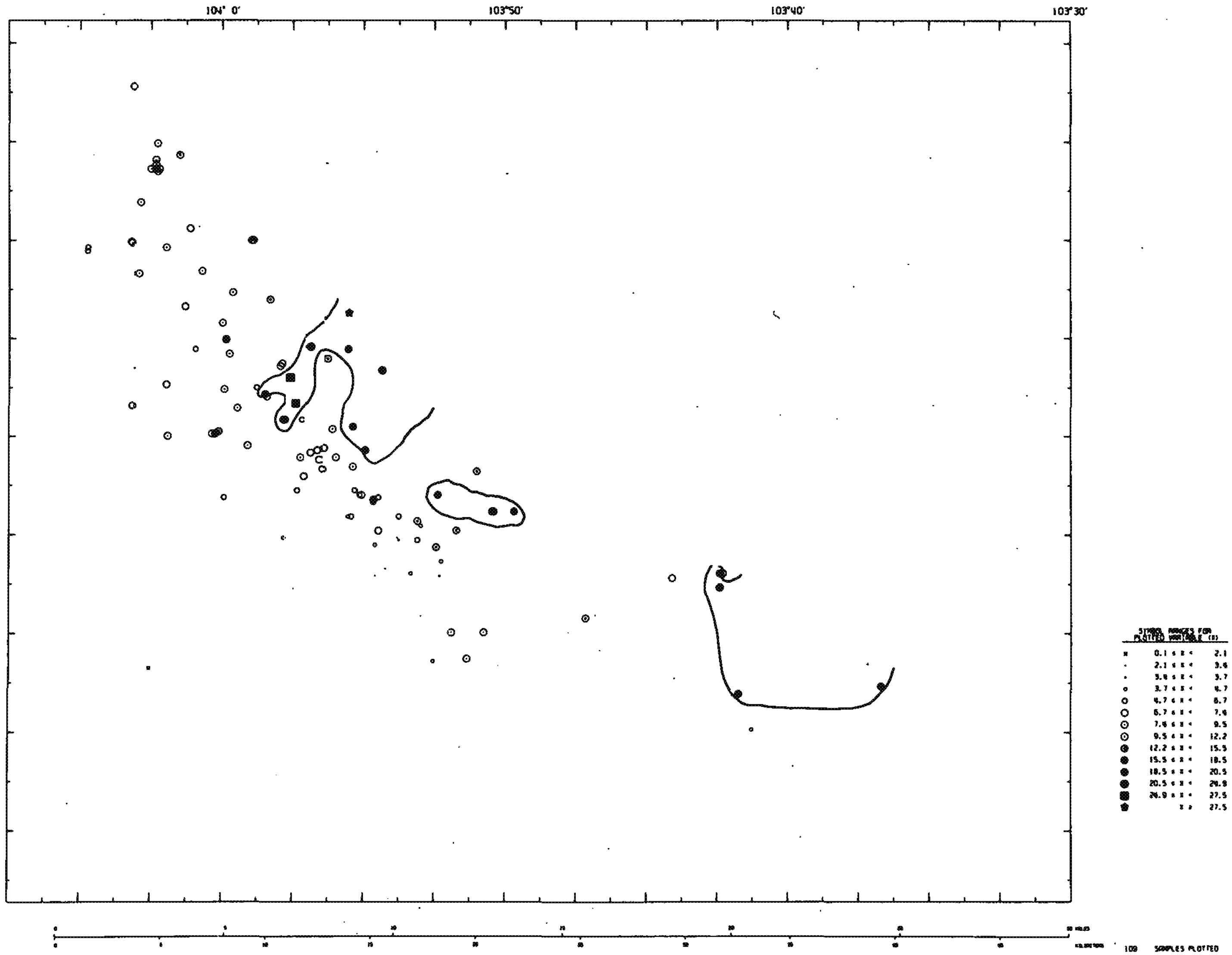


Figure A-8a

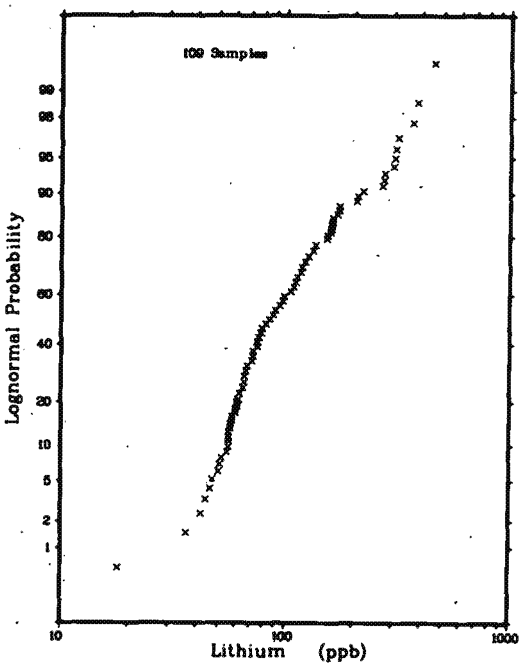
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR POTASSIUM (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

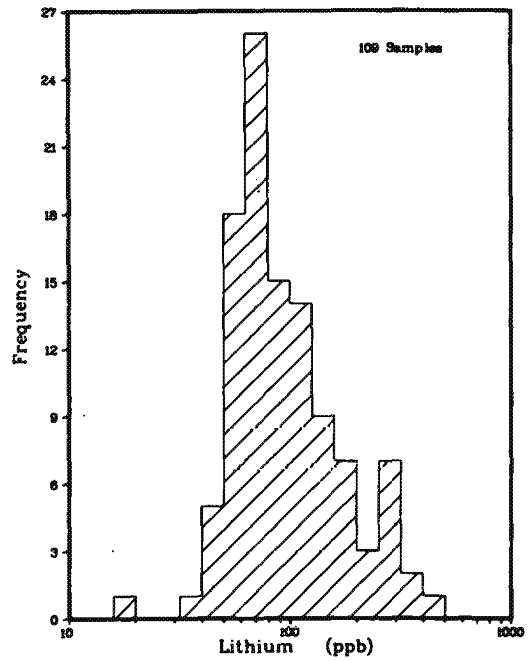


Approximate
Contour
≤15.5 ppm

Figure A-8b

GEOCHEMICAL DISTRIBUTION OF POTASSIUM (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





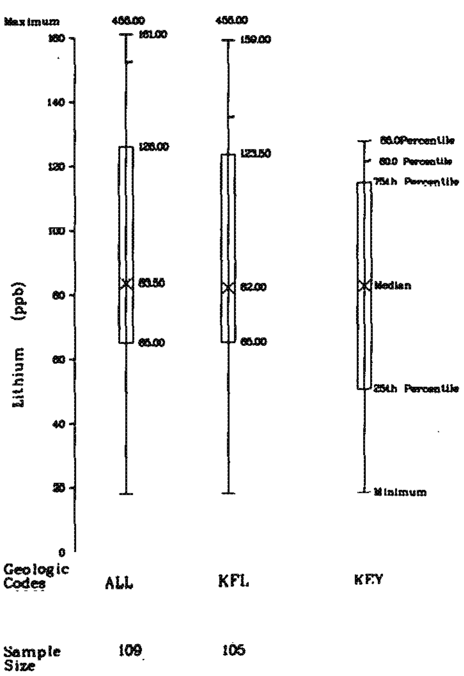
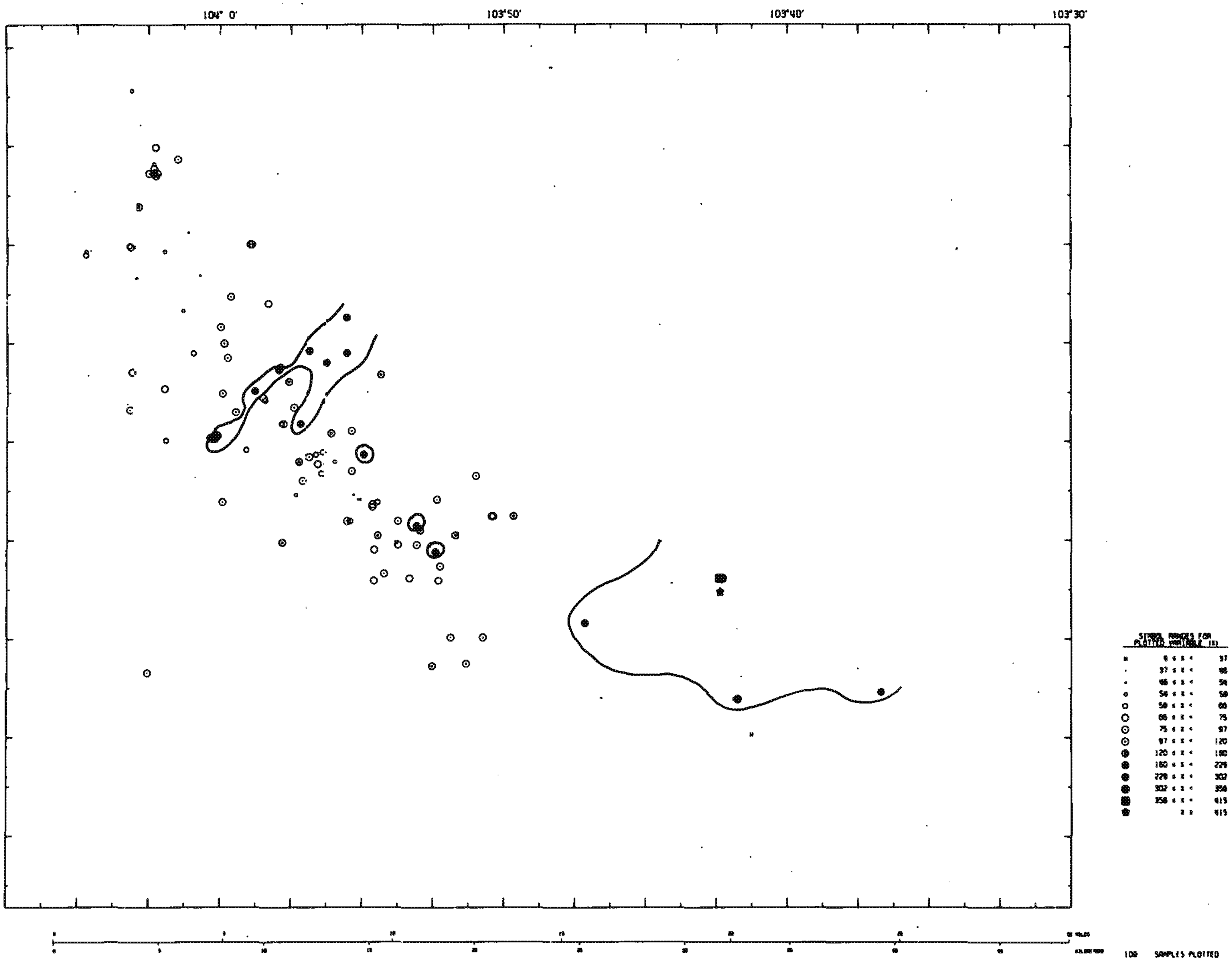


Figure A-9a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR LITHIUM (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤160 ppb

Figure A-9b

GEOCHEMICAL DISTRIBUTION OF LITHIUM (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

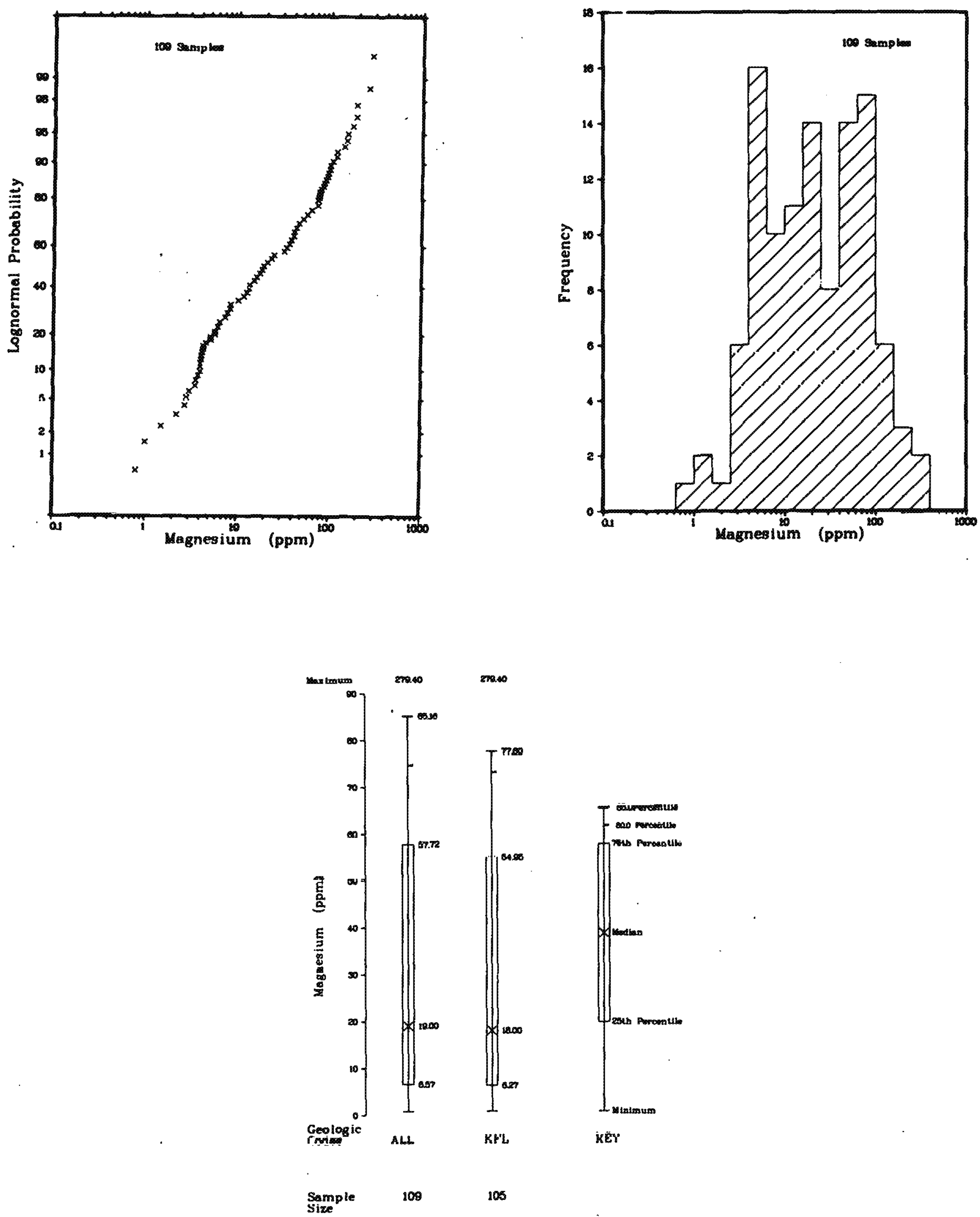
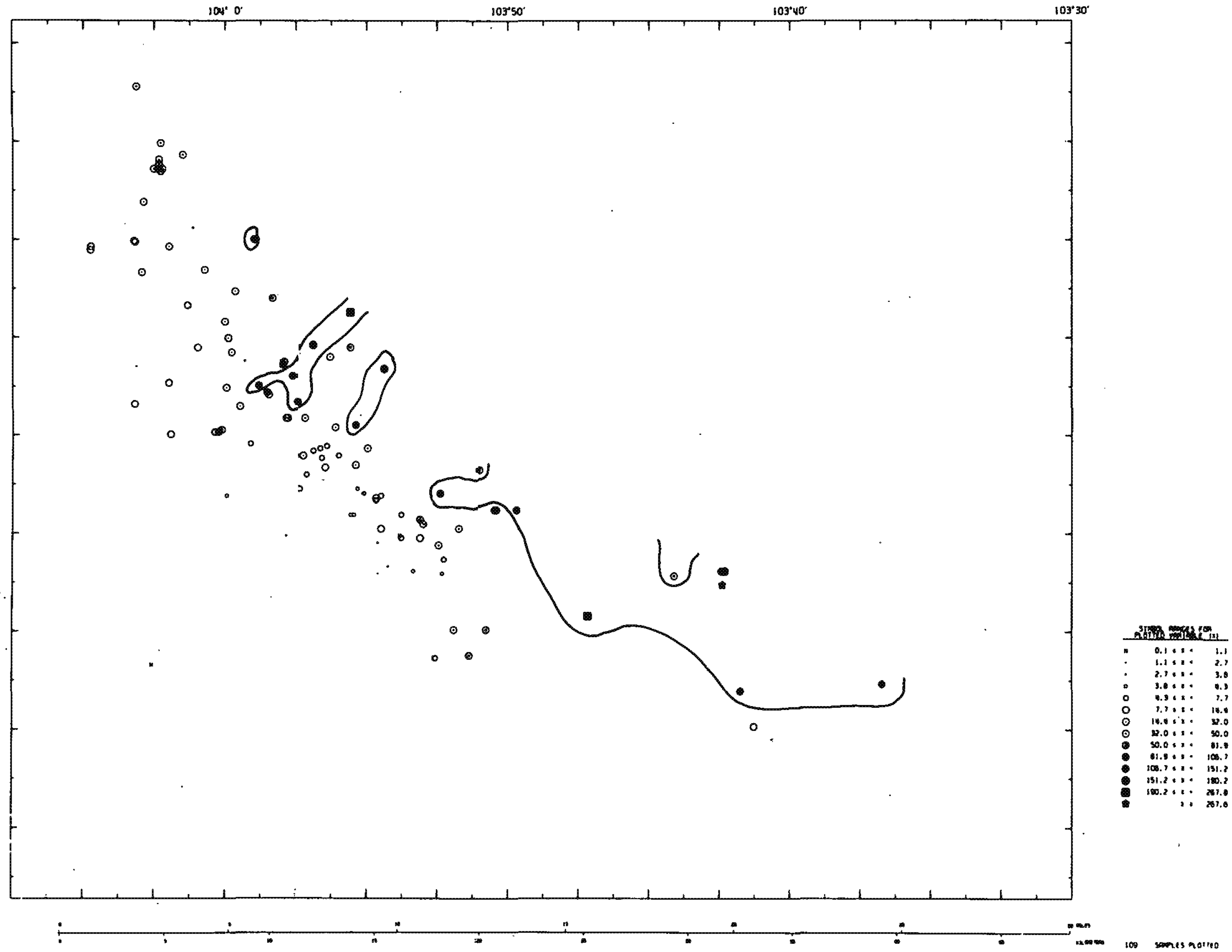


Figure A-10a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MAGNESIUM (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤81.9 ppm

Figure A-10b

GEOCHEMICAL DISTRIBUTION OF MAGNESIUM (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

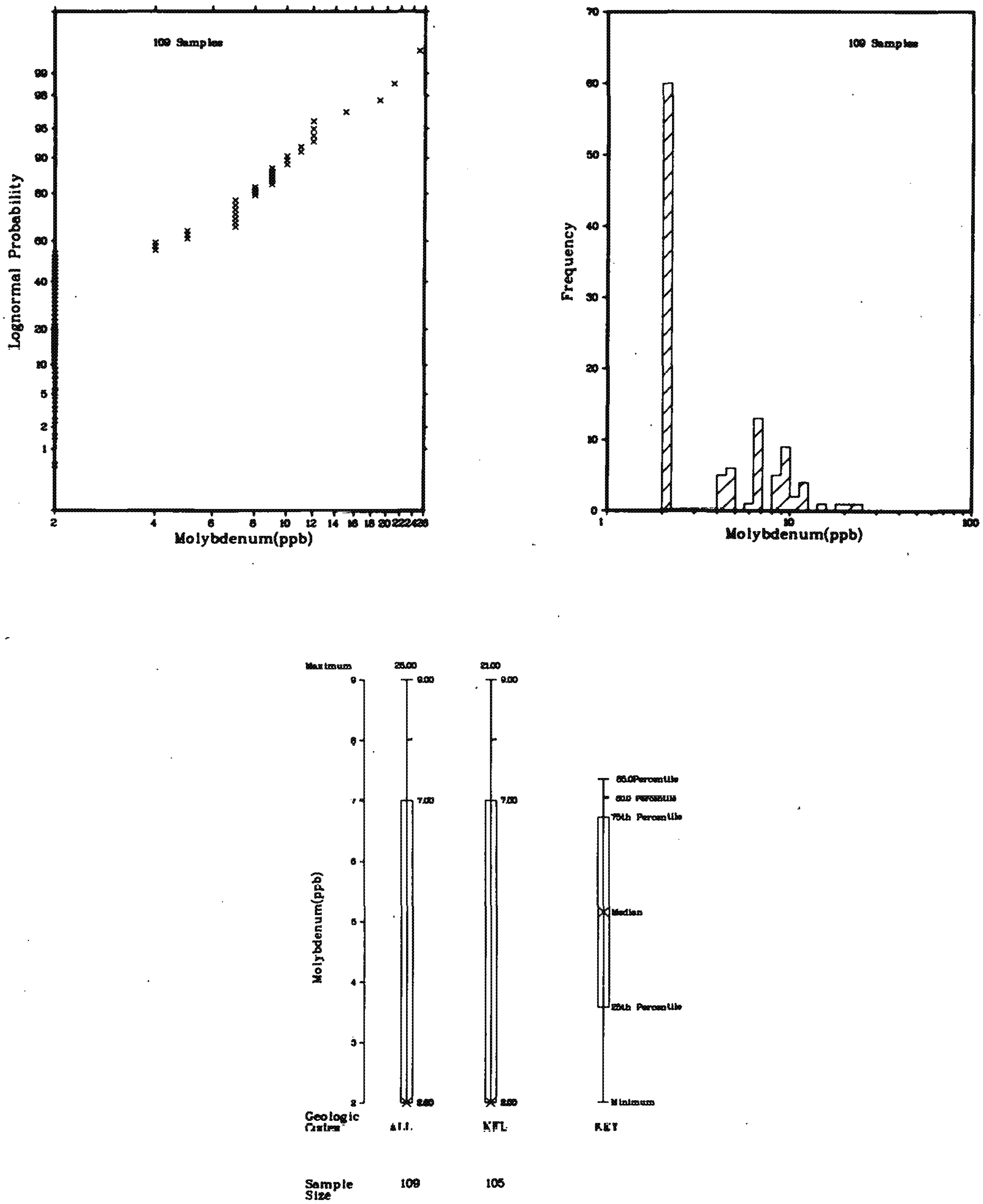
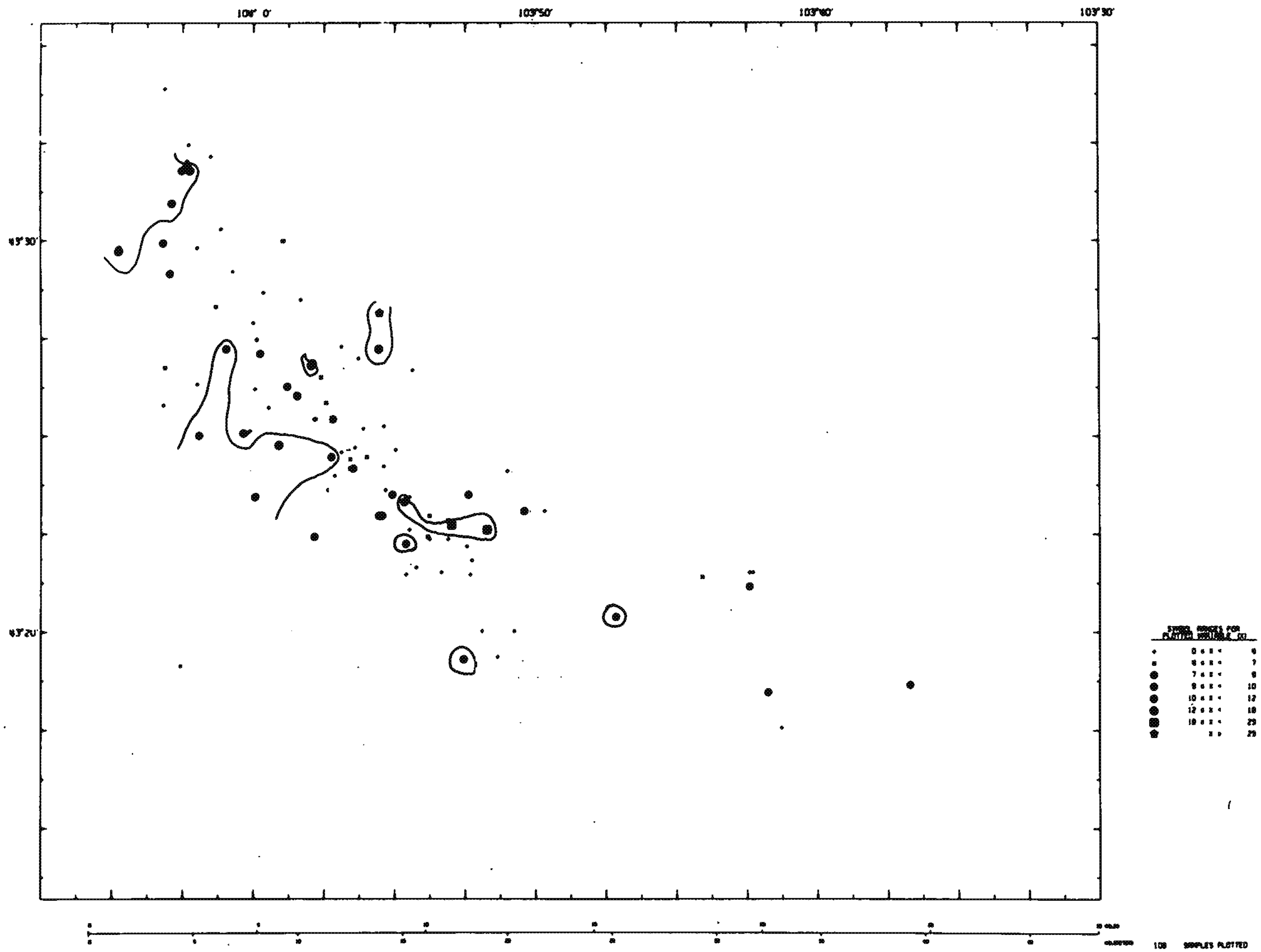


Figure A-11a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MOLYBDENUM (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤9 ppb

Figure A-11b

GEOCHEMICAL DISTRIBUTION OF MOLYBDENUM (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

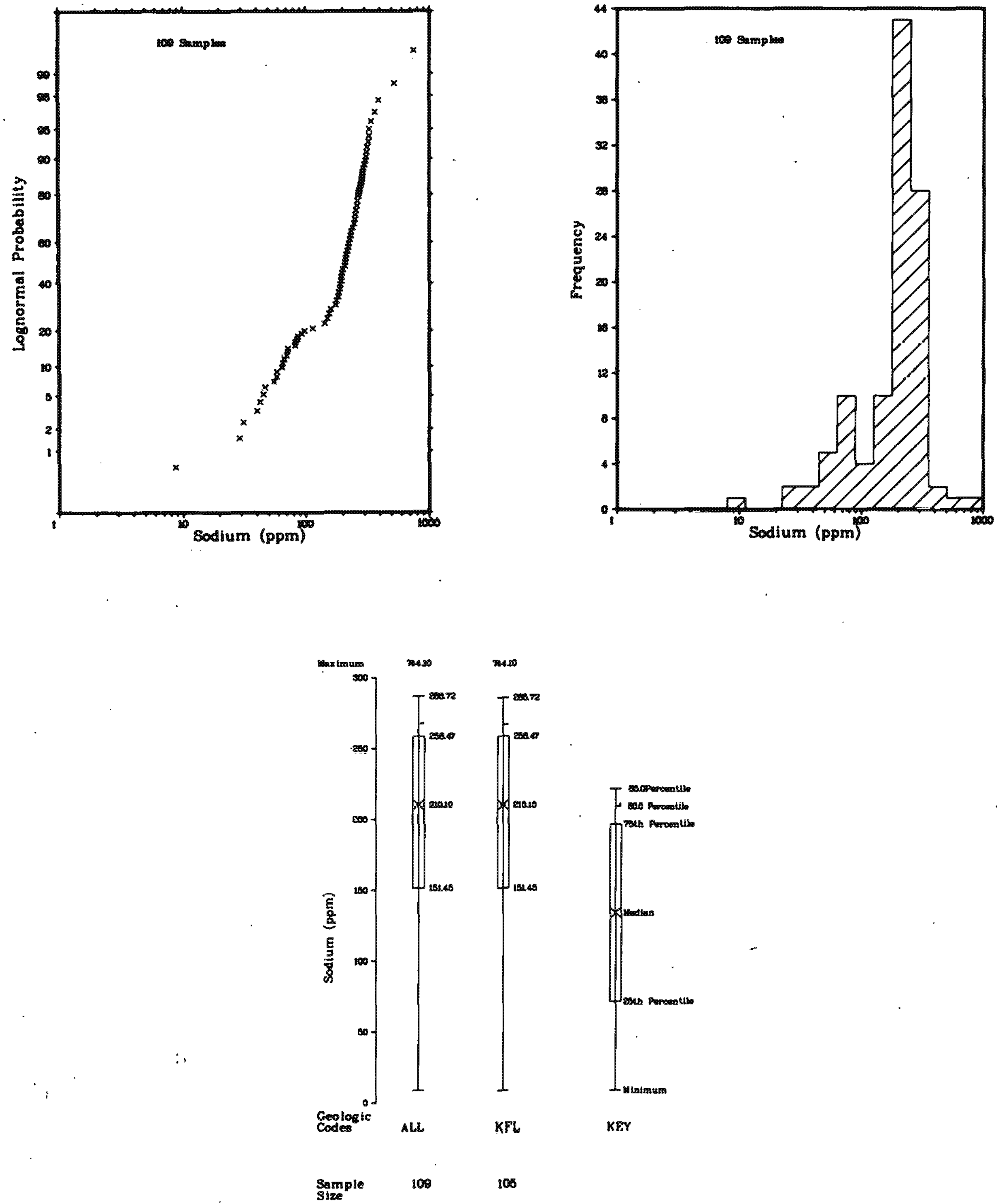
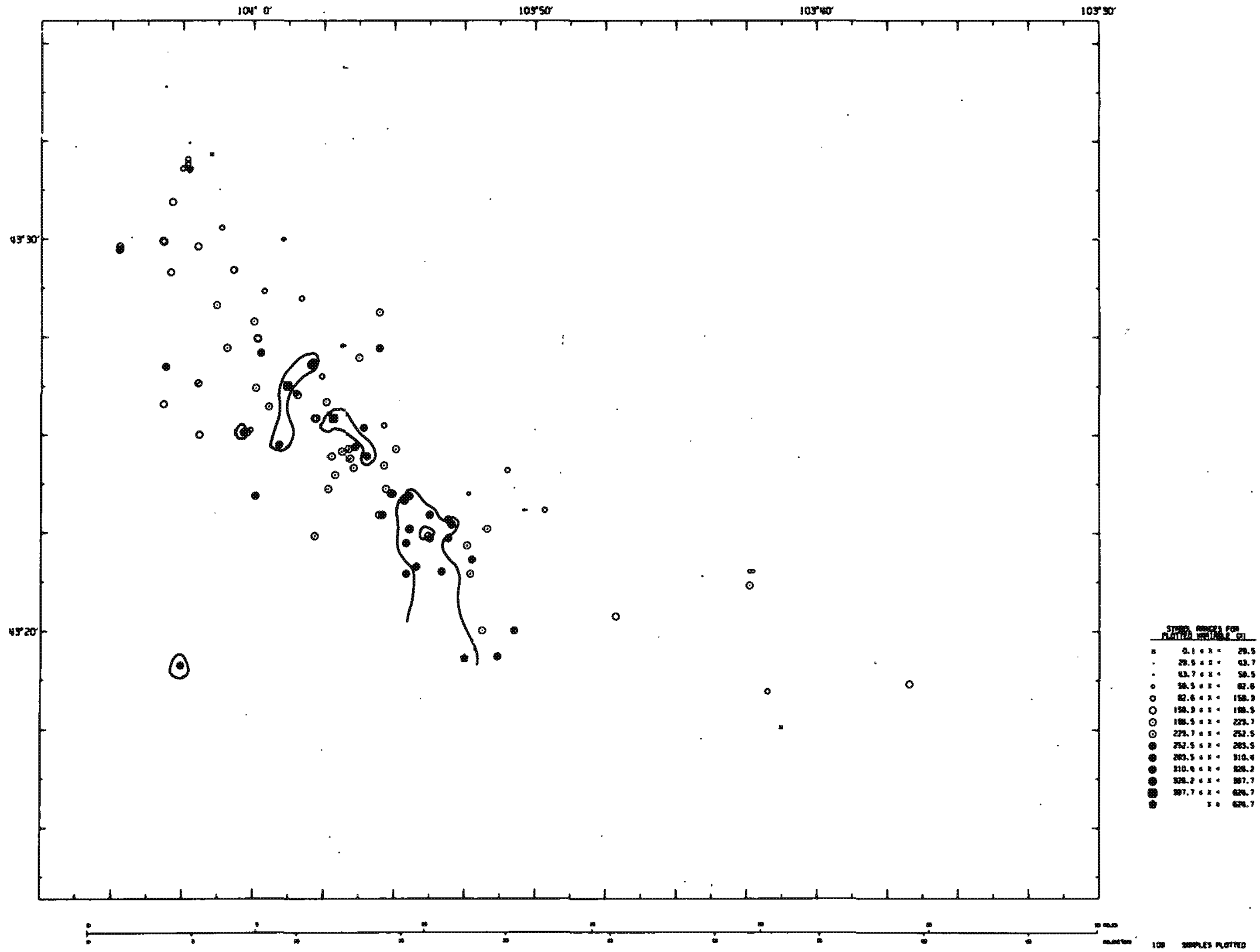


Figure A-12a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SODIUM (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤283.5 ppm

Figure A-12b

GEOCHEMICAL DISTRIBUTION OF SODIUM (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

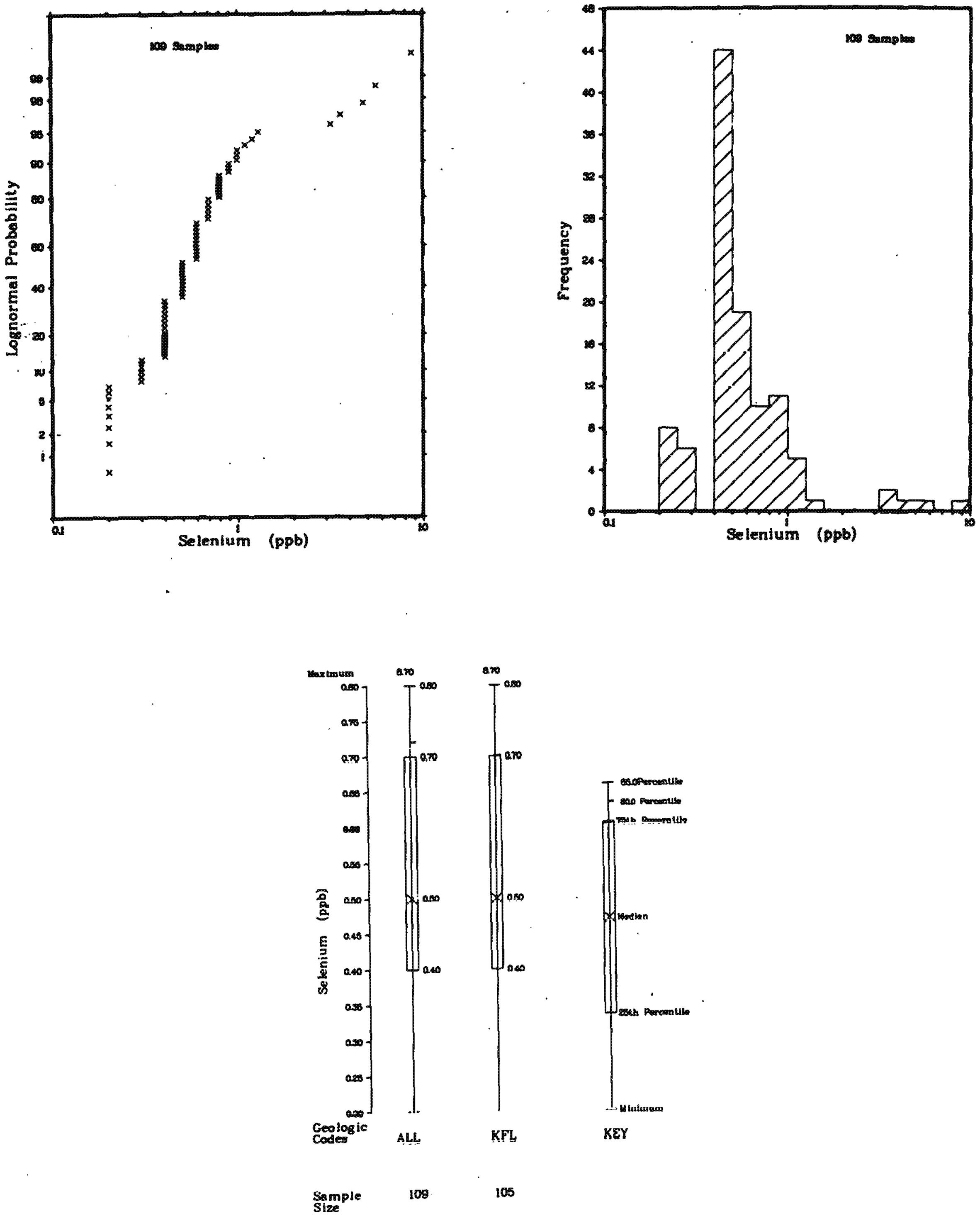
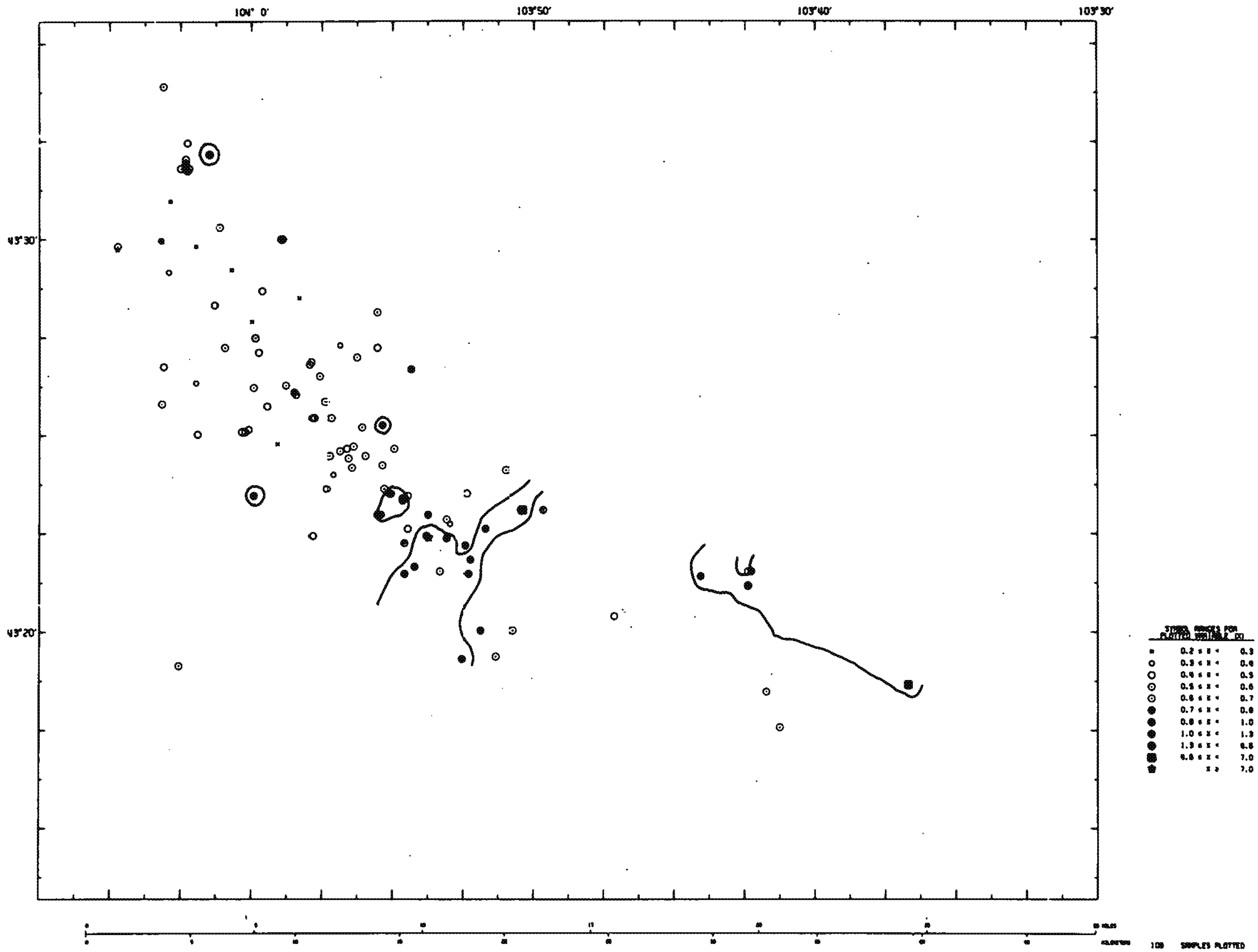


Figure A-13a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SELENIUM (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤0.8 ppb

Figure A-13b

GEOCHEMICAL DISTRIBUTION OF SELENIUM (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

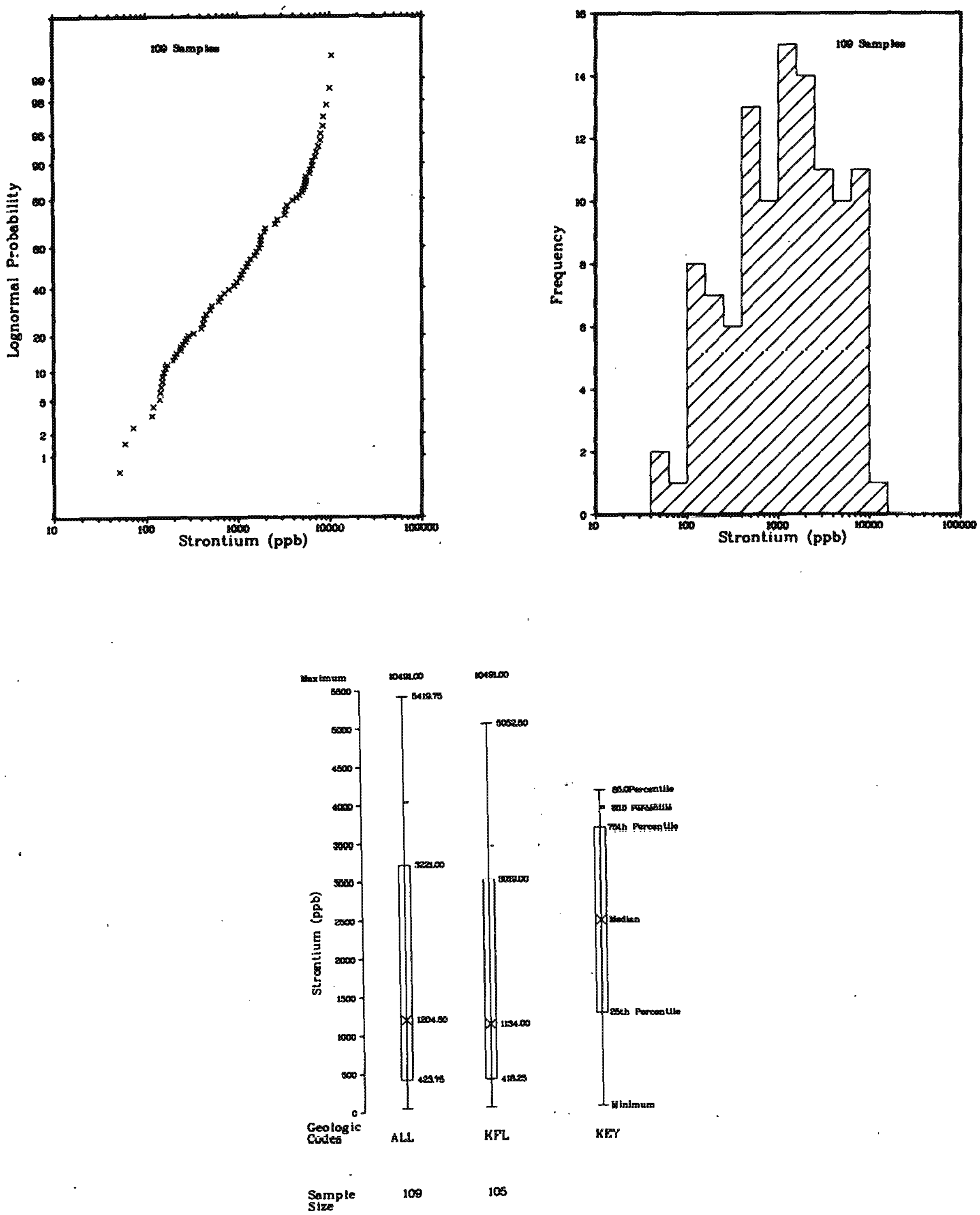
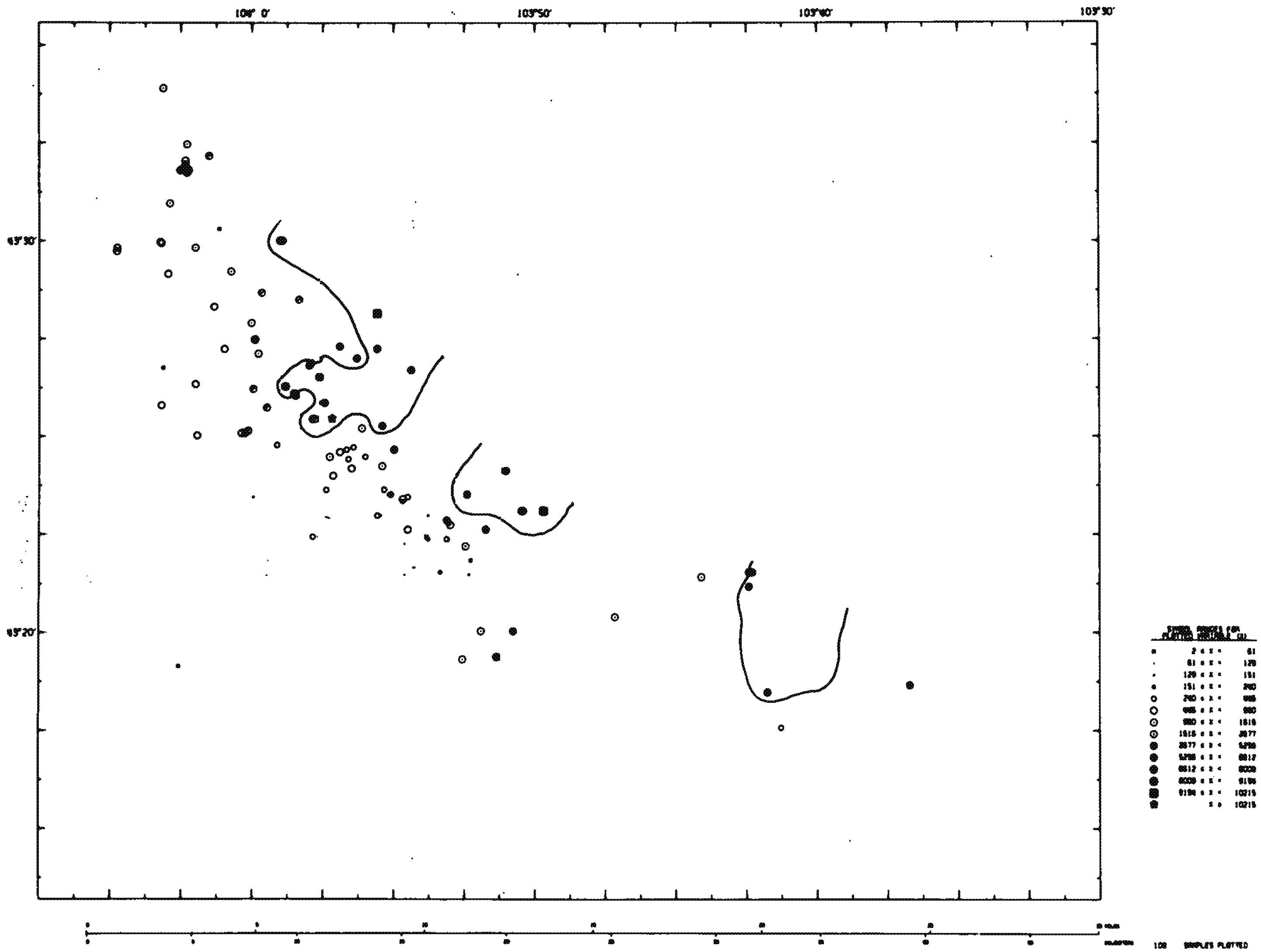


Figure A-14a

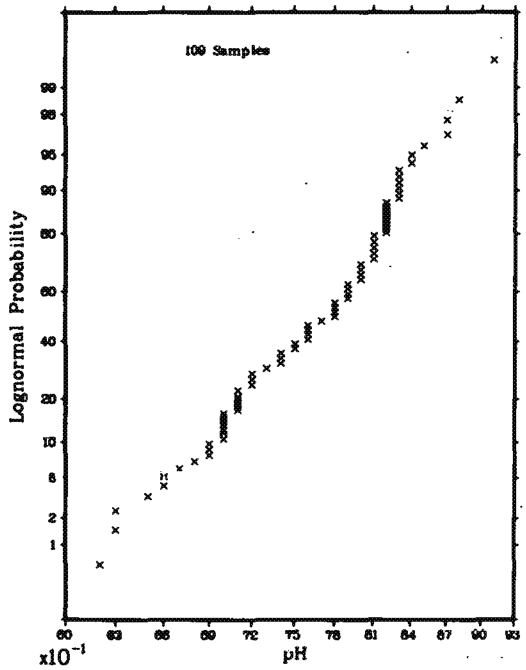
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR STRONTIUM (PPB)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

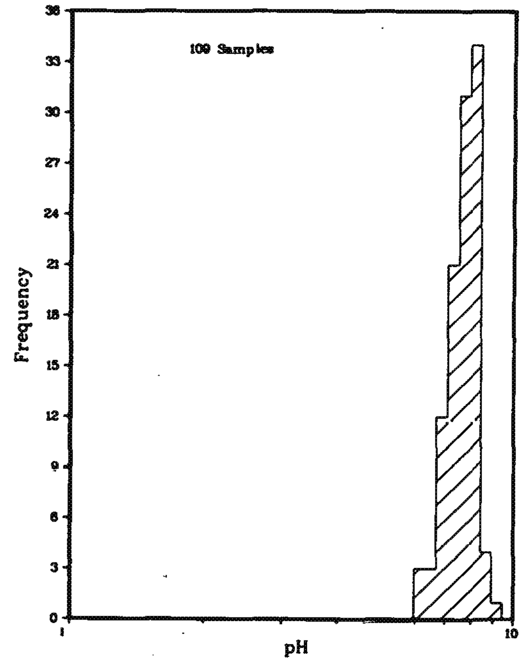


Approximate
Contour
≤5,256 ppb

Figure A-14b

GEOCHEMICAL DISTRIBUTION OF STRONTIUM (PPB) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





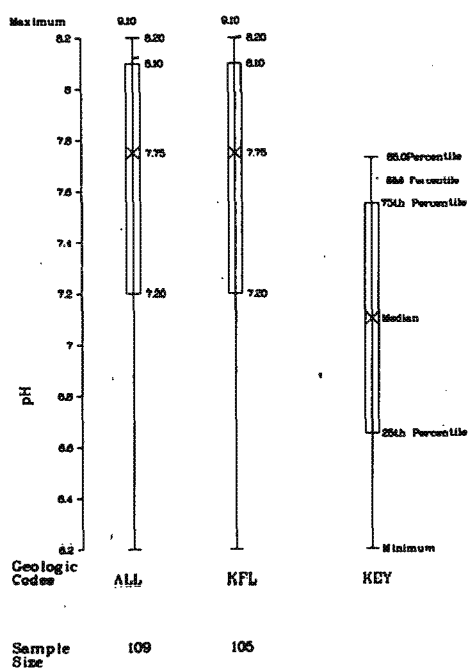
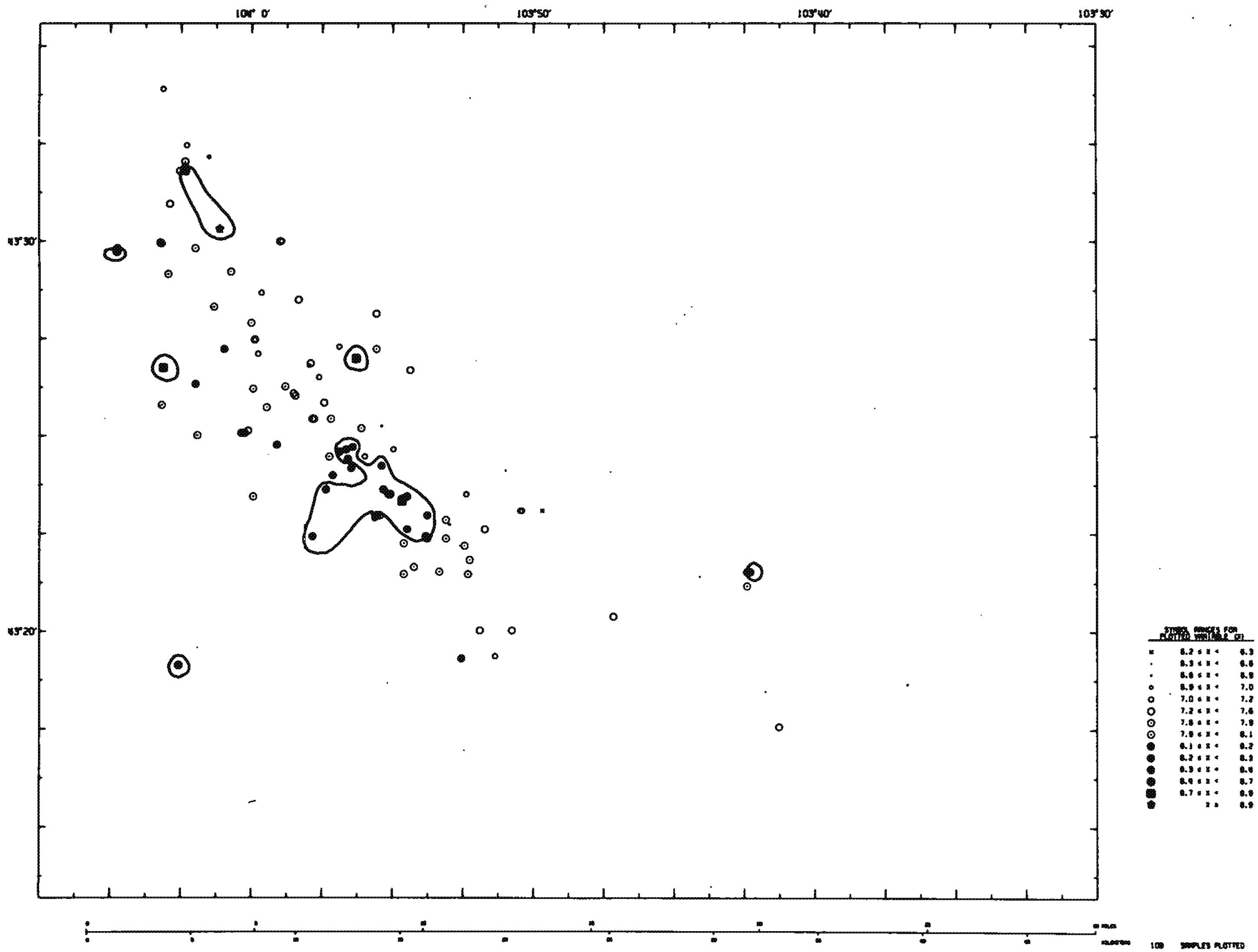


Figure A-15a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR pH
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤8.2

Figure A-15b

GEOCHEMICAL DISTRIBUTION OF pH IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

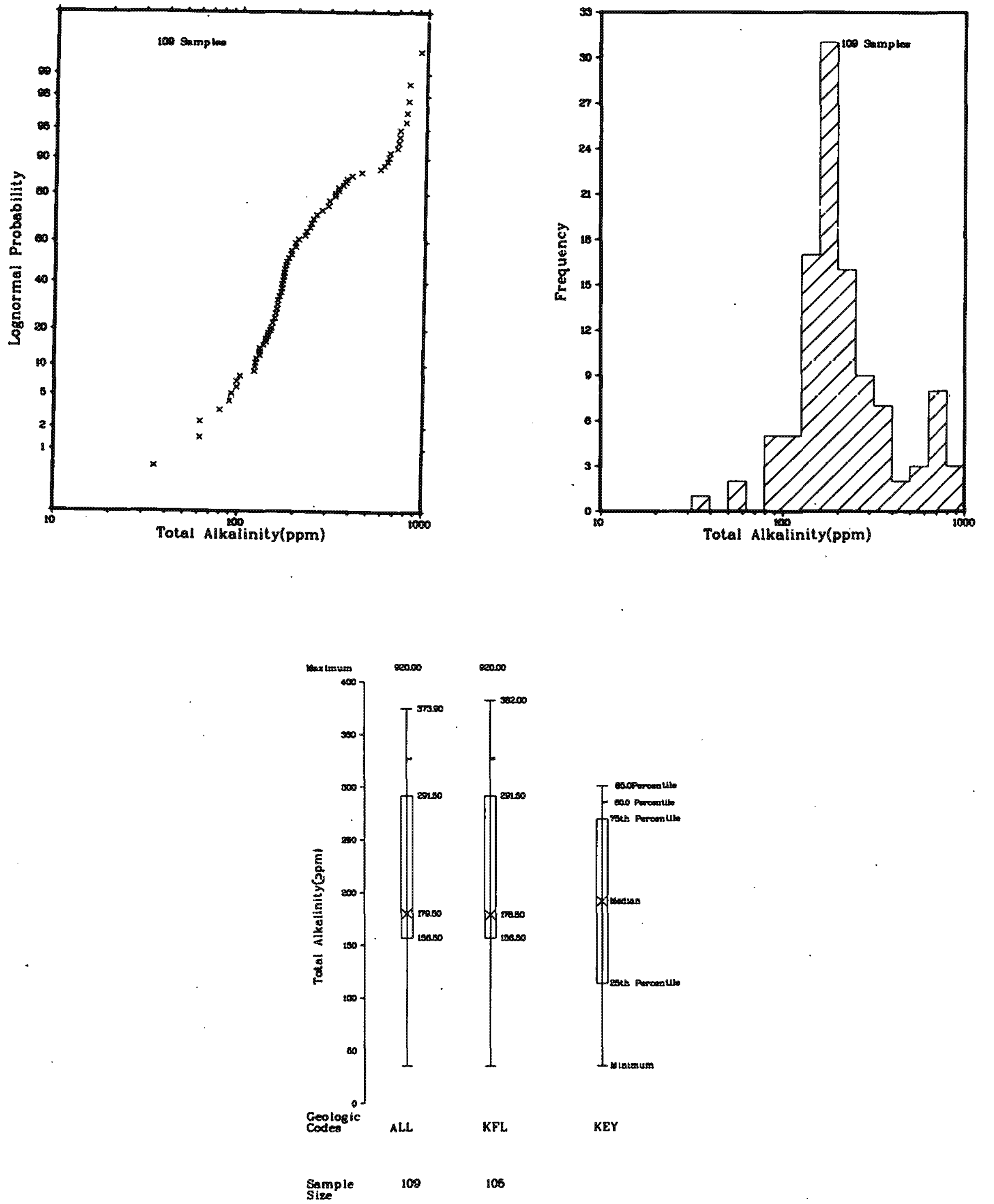
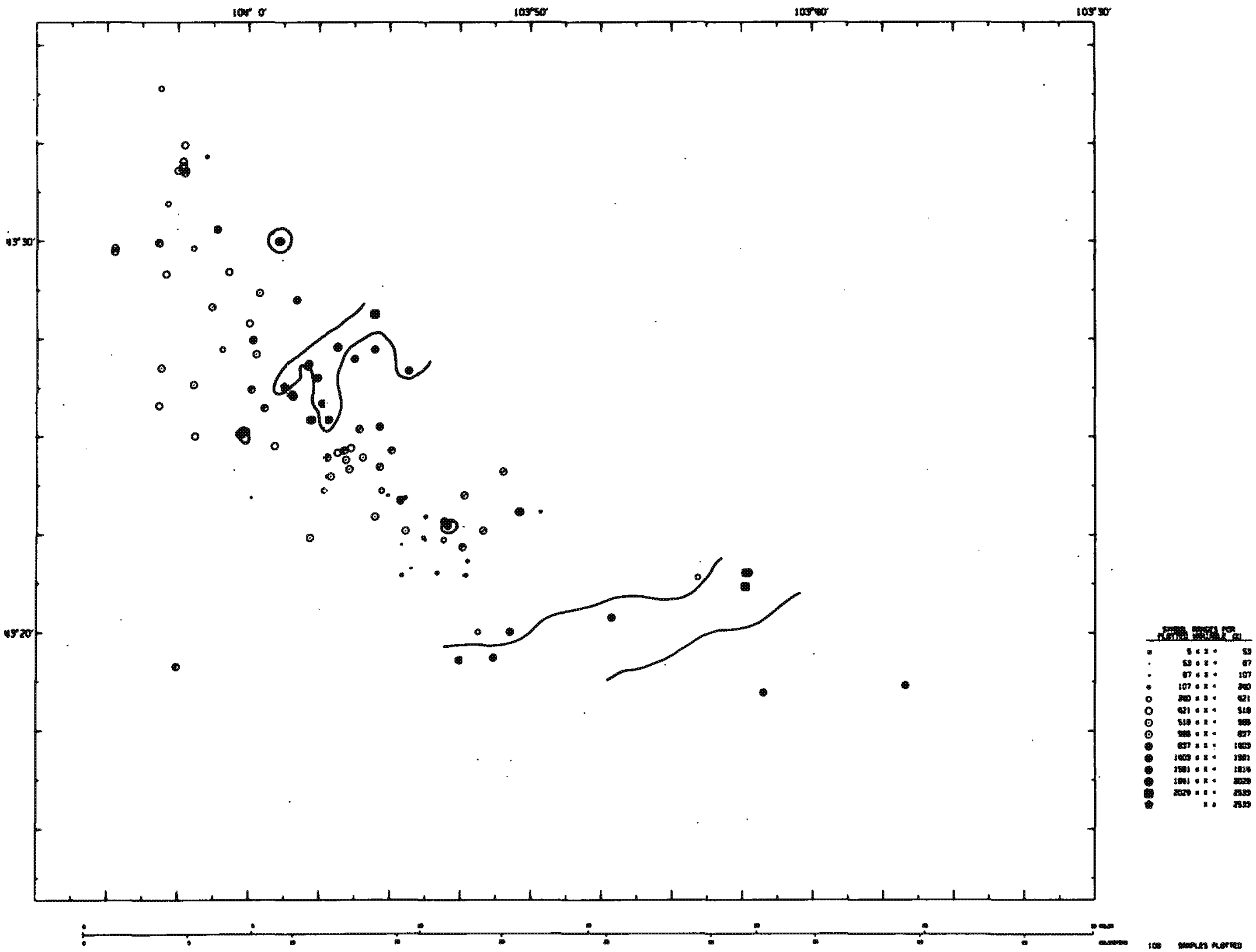


Figure A-16a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SULFATE (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤1,403 ppm

Figure A-16b

GEOCHEMICAL DISTRIBUTION OF SULFATE (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

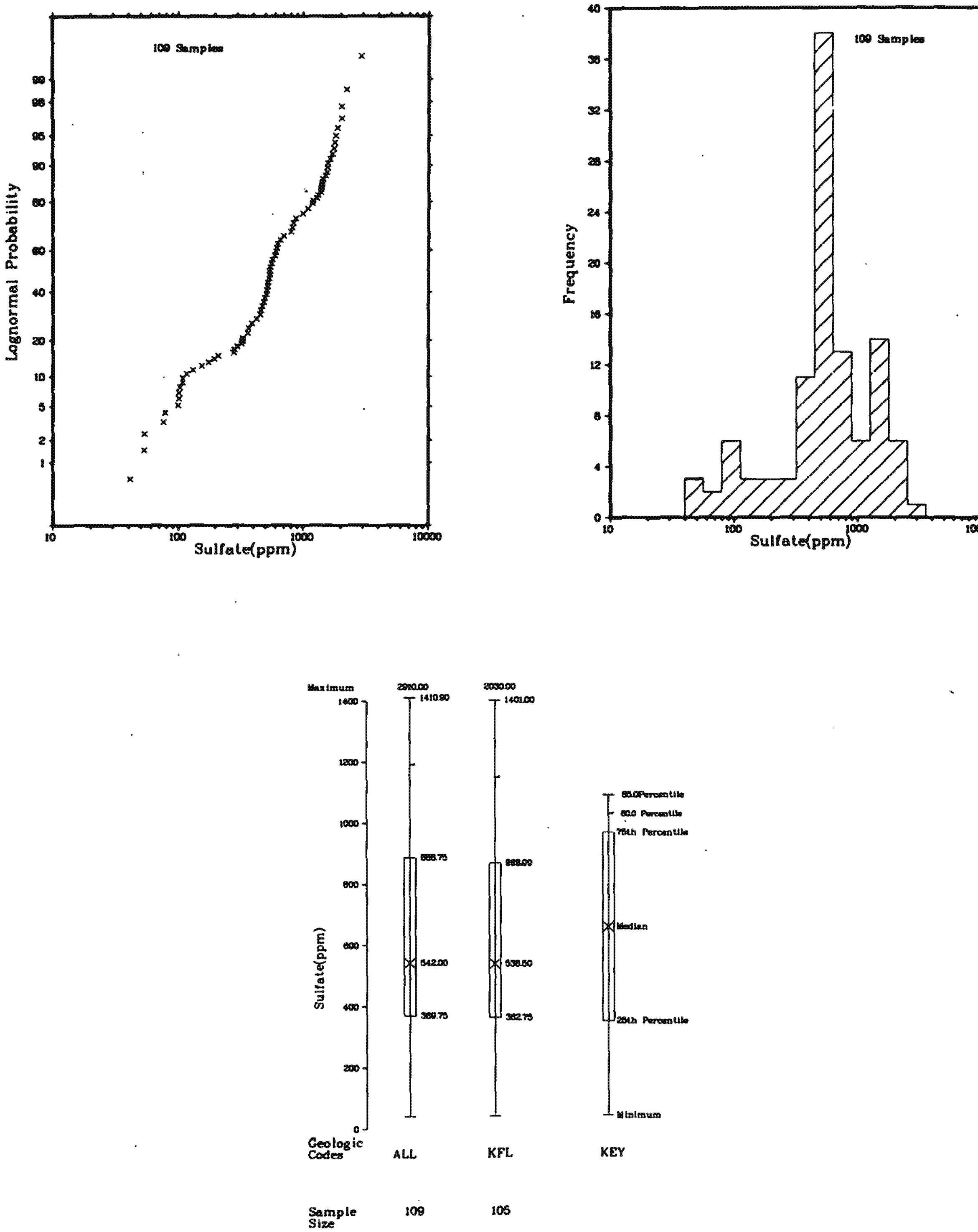
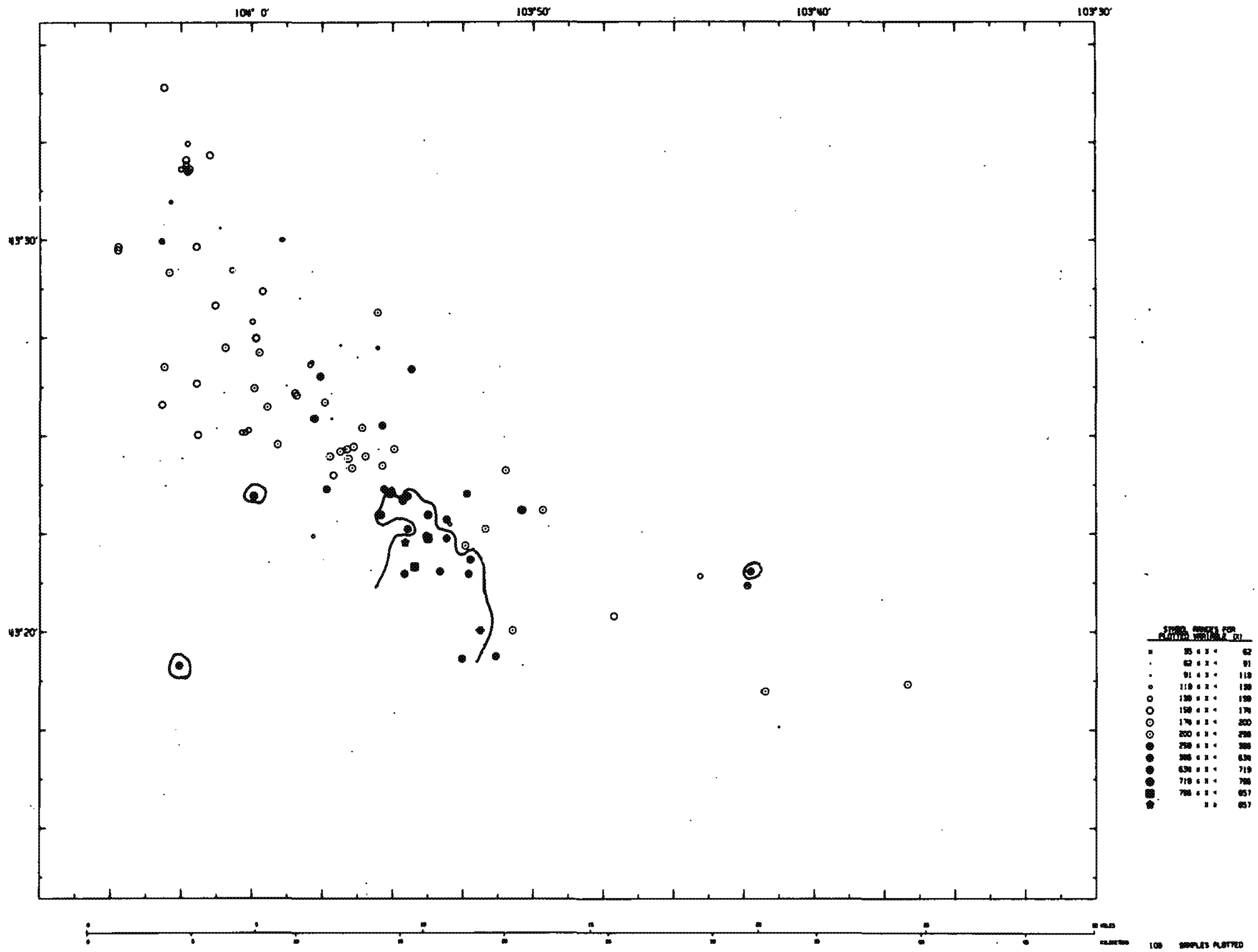


Figure A-17a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR TOTAL ALKALINITY (PPM)
IN GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤366 ppm

Figure A-17b

GEOCHEMICAL DISTRIBUTION OF TOTAL ALKALINITY (PPM) IN GROUNDWATER
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

Table A-3

PARTIAL DATA LISTING FOR GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY GROUNDWATER

OR SAMPLE NUMBER	D. O. E. ST LAT	SAMPLE LONG	NUMBER L TY REP	U (PPB)	SP UMHOS/CM	CA (PPM)	MG (PPM)	PH	SO4 (PPM)	AS (PPB)	MO (PPB)	SE (PPB)	V (PPB)	T-AK (PPM)
405089	46-43.500	-103.982	-3-03-	14.	3000	460.	95.	7.0	880	<0.5	<4	0.7	<4	130
405090	46-43.500	-103.983	-3-03-	15.	3000	510.	98.	7.2	1700	<0.5	<4	0.5	<4	120
405096	46-43.458	-103.998	-3-03-	0.70	1500	69.	24.	7.1	540	1.1	<4	0.6	<4	160
405225	46-43.340	-103.786	-3-03-	<0.20	4100	360.	260.	7.2	1800	<0.5	9	0.4	<4	170
405311	46-43.359	-103.707	-3-03-	0.66	4700	470.	140.	8.1	1800	<0.5	<4	0.5	<4	90
405312	46-43.359	-103.705	-3-03-	45.	3700	450.	190.	8.3	1900	0.5	<4	0.8	<4	370
405328	46-43.308	-103.696	-3-03-	1.5	2500	220.	120.	6.5	1100	<0.5	7	0.5	11	260
405330	46-43.293	-103.688	-3-01-	6.2	290	46.	10.	7.3	53	8.4	<4	0.6	15	98
405356	46-43.357	-103.735	-3-01-	37.	1400	180.	56.	6.3	330	1.5	5	0.8	<4	160
405357	46-43.353	-103.707	-3-03-	110.	4600	350.	280.	8.0	2800	1.4	7	1.3	<4	340
405379	46-43.311	-103.612	-3-03-	30.	3000	250.	89.	6.6	1100	0.5	7	4.8	<4	170
406430	46-43.447	-103.966	-3-03-	4.4	3200	150.	57.	6.9	1400	0.7	12	0.6	<4	140
406432	46-43.389	-103.911	-3-03-	<0.20	1700	5.8	4.3	8.7	380	0.5	12	0.8	4	710
406438	46-43.390	-103.911	-3-01-	0.49	2300	67.	41.	7.8	700	1.1	<4	0.8	<4	300
406439	46-43.392	-103.918	-3-03-	0.36	1100	8.5	4.1	8.1	100	0.5	7	0.8	<4	210
406440	46-43.392	-103.919	-3-03-	0.20	1300	5.5	2.8	8.3	78	<0.5	<4	0.7	5	450
406441	46-43.394	-103.922	-3-03-	<0.20	1400	10.	4.0	8.3	380	<0.5	<4	0.6	<4	300
406442	46-43.323	-103.856	-3-03-	<0.20	3300	180.	73.	7.0	1400	1.6	<4	0.6	<4	260
406443	46-43.322	-103.876	-3-03-	<0.20	5600	20.	7.6	8.1	1400	<0.5	11	0.9	<4	570
406444	46-43.358	-103.910	-3-03-	0.25	1800	1.0	1.5	8.0	130	48.	<4	1.0	4	720
406445	46-43.361	-103.904	-3-03-	<0.20	2000	1.4	3.0	7.8	76	31.	<4	1.0	<4	810
406446	46-43.383	-103.924	-3-03-	<0.20	1900	2.2	4.0	7.9	53	1.0	7	1.2	7	770
406447	46-43.383	-103.926	-3-03-	<0.20	1700	14.	4.2	8.4	540	1.0	7	0.4	<4	140
406448	46-43.394	-103.956	-3-03-	<0.20	1400	12.	5.2	8.2	300	1.4	<4	0.4	4	310
406449	46-43.400	-103.952	-3-03-	0.25	1700	21.	6.8	8.1	970	1.8	<4	0.3	4	170
406450	46-43.408	-103.954	-3-03-	0.42	1800	44.	16.	7.9	400	2.5	9	0.5	<4	180
406451	46-43.413	-103.985	-3-03-	<0.20	1400	12.	5.8	8.1	420	<0.5	15	0.2	4	170
406452	46-43.418	-104.006	-3-03-	<0.20	1600	37.	13.	8.1	450	0.6	8	0.4	8	140
406454	46-43.418	-104.004	-3-01-	3.9	3000	270.	84.	7.2	1400	1.2	<4	0.4	<4	160
406455	46-43.419	-104.002	-3-01-	0.82	2400	150.	74.	7.4	1100	<0.5	<4	0.4	<4	150
406456	46-43.319	-104.043	-3-03-	0.44	2200	2.7	0.8	8.5	650	<0.5	<4	0.6	5	380
406457	46-43.430	-104.053	-3-03-	2.0	1500	36.	12.	7.9	500	1.7	<4	0.5	<4	170
406458	46-43.417	-104.032	-3-03-	1.1	1500	35.	13.	8.0	450	0.9	9	0.4	7	170
406459	46-43.391	-103.999	-3-03-	0.46	1800	2.1	3.8	7.9	100	<0.5	10	0.9	<4	720
406460	46-43.374	-103.964	-3-03-	0.53	1600	13.	2.7	8.3	520	1.2	8	0.4	<4	120
406461	46-43.334	-103.846	-3-03-	0.39	3100	160.	65.	7.5	1300	<0.5	<4	0.6	<4	240
406462	46-43.358	-103.872	-3-03-	0.40	1900	1.9	4.0	7.6	210	54.	<4	0.9	<4	640
406463	46-43.364	-103.871	-3-03-	0.54	1800	2.8	5.8	7.6	300	46.	<4	1.0	6	620
406464	46-43.370	-103.874	-3-03-	2.1	2400	85.	40.	7.7	830	1.7	<4	0.7	<4	230
406465	46-43.402	-103.850	-3-03-	7.1	2100	200.	76.	6.3	830	0.9	<4	0.6	<4	250
406466	46-43.385	-103.840	-3-03-	20.	1800	150.	77.	7.0	620	1.0	7	5.6	<4	300
406467	46-43.385	-103.841	-3-03-	23.	1800	170.	74.	7.1	600	0.8	4	3.2	<4	250
406468	46-43.392	-103.873	-3-03-	21.	2200	170.	99.	7.1	630	0.6	7	0.4	<4	330
406469	46-43.383	-103.896	-3-03-	0.27	2100	2.1	4.6	8.2	110	1.1	4	0.7	<4	780
406470	46-43.391	-103.908	-3-03-	<0.20	1900	5.6	5.2	8.3	160	0.9	<4	0.4	4	630
406471	46-43.377	-103.908	-3-03-	0.35	2100	25.	8.6	8.2	520	4.5	<4	0.4	4	360
406472	46-43.371	-103.910	-3-03-	0.34	2100	1.6	3.5	8.0	100	18.	9	0.7	<4	920
406473	46-43.359	-103.889	-3-03-	0.44	1900	2.6	4.1	7.9	120	18.	<4	0.5	<4	700
406474	46-43.334	-103.865	-3-03-	0.25	1900	45.	37.	7.4	350	17.	<4	0.7	<4	400
406475	46-43.499	-104.053	-3-03-	4.3	1100	43.	13.	7.6	280	<0.5	8	0.2	8	120
406476	46-43.516	-104.048	-3-03-	2.2	1300	69.	21.	7.4	370	1.1	10	0.2	<4	140
406477	46-43.497	-104.033	-3-03-	1.3	1300	53.	21.	7.6	360	2.0	<4	0.2	<4	160
406478	46-43.458	-103.998	-3-03-	0.33	1400	72.	25.	7.5	380	1.7	<4	0.4	<4	160
406479	46-43.530	-104.037	-3-03-	0.22	1200	130.	41.	6.6	320	0.7	9	0.4	<4	180
406481	46-43.532	-104.039	-3-03-	7.5	1300	120.	33.	7.0	460	0.8	9	0.7	<4	160

Table A-3, Continued

PARTIAL DATA LISTING FOR GROUNDWATER OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY GROUNDWATER

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPB)	SP UMHOS/CM	CA (PPM)	MG (PPM)	PH	SO4 (PPM)	AS (PPB)	MO (PPB)	SE (PPB)	V (PPB)	T-AK (PPM)
406482	46-43.529	-104.038	-3-03-	9.5	1200	120.	37.	6.9	450	0.8	<4	0.4	<4	180
406483	46-43.530	-104.039	-3-03-	0.49	850	44.	19.	8.2	330	0.6	<4	0.5	<4	35
406484	46-43.530	-104.042	-3-03-	6.4	1200	120.	37.	7.2	550	0.5	11	0.5	4	150
406485	46-43.534	-104.039	-3-03-	1.5	1200	61.	19.	7.6	460	0.9	<4	0.6	<4	160
406486	46-43.541	-104.038	-3-03-	11.	1100	140.	45.	7.1	470	0.5	<4	0.4	<4	150
406487	46-43.565	-104.052	-3-03-	4.5	1100	110.	38.	7.1	330	0.9	<4	0.6	<4	160
406488	46-43.536	-104.025	-3-03-	15.	1200	180.	43.	6.9	110	0.5	<4	3.6	<4	160
406489	46-43.505	-104.019	-3-03-	2.0	860	6.2	3.6	9.1	880	0.5	<4	0.5	<4	92
409489	46-43.404	-103.923	-3-03-	<0.20	2000	49.	18.	8.2	670	1.0	<4	0.5	<4	160
409490	46-43.385	-103.828	-3-03-	2.1	3400	320.	150.	6.2	1800	0.6	<4	0.7	<4	200
409491	46-43.374	-103.897	-3-03-	<0.20	1100	2.8	1.0	8.3	41	0.5	5	0.8	4	340
409492	46-43.373	-103.896	-3-03-	<0.20	2000	4.0	4.3	7.8	99	4.8	<4	8.7	4	800
409493	46-43.373	-103.885	-3-03-	<0.20	2100	5.1	8.3	7.9	360	11.	<4	0.8	<4	600
409494	46-43.411	-103.944	-3-03-	0.43	1600	16.	5.9	8.2	620	0.8	<4	0.4	<4	180
409495	46-43.410	-103.948	-3-03-	0.85	1700	22.	7.4	8.2	510	1.4	<4	0.5	7	160
409496	46-43.407	-103.943	-3-03-	0.21	1700	16.	6.2	8.2	560	0.5	5	0.5	<4	190
409498	46-43.403	-103.941	-3-03-	0.26	1600	19.	7.8	8.1	540	0.8	8	0.6	<4	200
409499	46-43.434	-103.974	-3-03-	<0.20	1600	33.	13.	7.9	570	0.6	7	0.5	<4	170
409500	46-43.435	-103.975	-3-03-	0.75	2500	200.	79.	7.4	1200	0.5	<4	0.7	<4	240
409501	46-43.379	-103.883	-3-03-	32.	3600	180.	41.	6.7	1600	<0.5	19	0.3	<4	130
409502	46-43.411	-103.916	-3-03-	0.41	2700	120.	46.	7.0	750	0.9	<4	0.6	<4	240
409503	46-43.421	-103.923	-3-03-	2.9	2700	270.	93.	6.8	1300	0.8	<4	0.8	<4	330
409504	46-43.445	-103.906	-3-03-	5.3	3100	360.	150.	7.2	1600	<0.5	<4	0.7	<4	300
409505	46-43.450	-103.938	-3-03-	<0.20	2000	82.	32.	8.8	850	<0.5	<4	0.5	<4	62
409506	46-43.454	-103.926	-3-03-	0.20	3000	150.	63.	7.7	1200	0.6	12	0.4	4	130
409507	46-43.469	-103.926	-3-03-	8.0	3900	310.	190.	7.3	2200	<0.5	25	0.6	<4	230
409508	46-43.455	-103.948	-3-03-	0.59	3400	400.	170.	7.1	2000	<0.5	<4	0.3	<4	98
409509	46-43.442	-103.960	-3-03-	4.3	3000	310.	120.	7.0	1600	0.7	5	0.6	<4	280
409510	46-43.448	-103.965	-3-03-	3.5	3200	140.	51.	7.4	1600	<0.5	7	0.5	<4	130
409511	46-43.424	-103.963	-3-03-	0.76	2000	110.	43.	7.5	820	0.9	<4	0.6	<4	230
409512	46-43.424	-103.964	-3-03-	0.37	1400	56.	23.	7.8	530	1.1	<4	0.4	<4	160
409513	46-43.424	-103.953	-3-03-	0.45	3200	83.	34.	8.0	1500	<0.5	7	0.5	4	100
409514	46-43.431	-103.957	-3-03-	0.78	2700	200.	86.	7.5	1400	<0.5	4	0.5	<4	180
409515	46-43.377	-103.862	-3-03-	<0.20	2200	110.	49.	7.4	800	1.0	21	1.1	<4	240
409516	46-43.381	-103.885	-3-03-	9.7	2500	120.	58.	7.6	1000	1.0	5	0.6	<4	270
409517	46-43.406	-103.933	-3-03-	<0.20	1700	16.	6.5	7.0	560	0.5	5	0.5	<4	170
409518	46-43.420	-103.935	-3-03-	<0.20	1800	44.	15.	7.8	620	1.0	<4	0.6	<4	200
409519	46-43.412	-103.940	-3-03-	<0.20	1600	17.	6.2	8.2	510	<0.5	<4	0.6	<4	190
409520	46-43.438	-103.980	-3-03-	<0.20	5900	330.	100.	7.9	2900	<0.5	8	0.5	<4	80
409521	46-43.437	-103.999	-3-03-	0.32	1600	52.	17.	7.8	610	0.8	<4	0.5	<4	210
409522	46-43.429	-103.991	-3-03-	0.67	1800	48.	17.	7.8	660	0.7	<4	0.4	<4	200
409523	46-43.454	-104.016	-3-03-	7.9	1500	33.	11.	8.1	420	1.1	10	0.6	<4	170
409524	46-43.439	-104.033	-3-03-	0.33	1600	23.	8.1	8.1	550	1.0	<4	0.3	7	170
409525	46-43.446	-104.052	-3-03-	0.24	1600	6.4	2.2	8.7	530	1.4	4	0.4	<4	190
409526	46-43.472	-104.022	-3-03-	16.	1400	34.	12.	8.0	520	<0.5	4	0.4	<4	170
409527	46-43.497	-104.079	-3-03-	2.8	1500	26.	8.3	8.1	540	2.8	6	0.5	<4	180
409528	46-43.496	-104.079	-3-03-	3.6	1500	25.	8.4	8.4	510	2.0	12	0.2	<4	170
409529	46-43.486	-104.049	-3-03-	6.4	1400	43.	16.	7.9	480	1.6	7	0.3	<4	180
409530	46-43.452	-103.996	-3-03-	0.60	1700	43.	15.	7.1	570	0.9	7	0.4	<4	210
409532	46-43.475	-103.972	-3-03-	0.28	1800	170.	77.	7.5	840	<0.5	<4	0.2	<4	62
409533	46-43.478	-103.994	-3-03-	0.45	1300	72.	25.	7.1	520	0.6	<4	0.4	<4	170
409534	46-43.465	-104.000	-3-03-	0.50	1400	52.	18.	7.6	510	1.1	<4	0.2	<4	150
409535	46-43.487	-104.012	-3-03-	2.1	1300	51.	19.	7.7	450	1.2	<4	0.2	<4	140
409536	46-43.499	-104.054	-3-03-	2.1	1300	38.	14.	8.0	460	0.6	<4	0.3	<4	150

APPENDIX B

STREAM SEDIMENT

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APPENDIX B

STREAM SEDIMENT

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Table B-1

STATISTICAL SUMMARY FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

ELEMENT	NO. SAMPLES ANALYZED: MEASURABLE VALUES	NO. SAMPLES ANALYZED: BELOW DETECTION LIMIT	DETECTION LIMIT	MINIMUM VALUE	MAXIMUM VALUE	MEAN	MEDIAN	MODE	STANDARD DEVIATION	COEFFICIENT OF VARIATION	LN TRANSFORMATION: MEAN	LN TRANSFORMATION: S. D.	LN TRANSFORMATION: ROBUST MEAN	LN TRANSFORMATION: ROBUST S. D.
U-FL	419			0.70	230.70	6.38	2.75	1.98	18.767	2.940	1.18	0.81	1.10	0.78
U-NT	419			1.00	251.30	6.80	3.30	2.06	18.662	2.744	1.34	0.74	1.25	0.67
TH	393	26	<2	<2	53	6	6	5	5.3	0.8	1.74	0.53	1.70	0.52
U/TU	419			0.06	1.55	0.93	0.89	0.84	0.402	0.433	-0.14	0.38	-0.12	0.24
TH/U	419			0.03	18.52	1.75	1.60	1.80	1.450	0.827	0.29	0.84	0.36	0.80
AG	7	412	<2	<2	9	5	<2	<2	3.5	0.6	1.52	0.77		
AL	419			1.31	10.68	4.10	3.98	5.16	1.517	0.370	1.34	0.40	1.35	0.42
AS	418			0.8	88.2	4.6	3.5	3.2	6.27	1.36	1.31	0.56	1.29	0.54
B	406	13	<10	<10	87	32	28	25	15.2	0.5	3.36	0.49	3.33	0.53
BA	419			146	2649	391	372	355	172.1	0.4	5.91	0.33	5.91	0.33
BE	399	20	<1	<1	3	1	<1	<1	0.5	0.4	0.23	0.34		
CA	419			0.06	14.96	2.09	0.83	0.35	2.459	1.177	0.02	1.26	0.02	1.19
CE	419			11	112	47	47	44	14.5	0.3	3.81	0.33	3.82	0.32
CO	364	55	<4	<4	30	7	6	6	3.2	0.4	1.90	0.37	1.80	0.43
CR	419			9	90	31	30	20	13.5	0.4	3.36	0.45	3.37	0.45
CU	419			4	36	14	13	11	6.1	0.4	2.55	0.44	2.56	0.45
FE	419			0.46	19.19	1.89	1.70	1.50	1.250	0.662	0.51	0.49	0.52	0.50
K	419			0.34	2.11	1.11	1.15	1.25	0.348	0.314	0.04	0.36	0.06	0.37
LI	419			8	175	29	27	17	15.8	0.5	3.24	0.52	3.25	0.53
MG	419			0.12	3.38	0.84	0.58	0.36	0.721	0.854	-0.47	0.76	-0.48	0.77
MN	419			39	4849	334	292	279	313.4	0.9	5.61	0.63	5.61	0.60
MO	40	379	<4	<4	66	12	<4	<4	14.7	1.2	2.11	0.78		
NA	407	12	<0.05	<0.05	2.10	0.31	0.28	0.17	0.211	0.673	-1.37	0.69	-1.40	0.75
NB	318	101	<4	<4	24	5	5	6	2.5	0.4	1.71	0.30		
NI	419			2	73	14	14	12	8.2	0.6	2.54	0.58	2.55	0.55
P	419			61	1313	493	465	375	250.3	0.5	6.04	0.63	6.07	0.68
SC	419			2	17	5	5	5	2.2	0.4	1.61	0.42	1.62	0.43
SE	400	18	<0.1	<0.1	86.8	1.5	0.6	0.4	6.03	4.10	-0.45	0.97	-0.58	1.08
SR	419			25	1154	158	105	60	158.0	1.0	4.75	0.75	4.73	0.78
TI	419			459	4435	1793	1807	1830	538.0	0.3	7.44	0.32	7.46	0.32
V	419			17	470	65	55	46	48.8	0.7	4.03	0.52	4.01	0.49
Y	419			4	31	12	12	13	3.7	0.3	2.50	0.29	2.50	0.28
ZN	419			11	168	52	47	48	25.2	0.5	3.83	0.52	3.85	0.53
ZR	419			19	111	64	65	67	14.5	0.2	4.15	0.24	4.16	0.25

NOTE: Refer to Table 1, Page 25 and Table C-1, Page C-4 for concentration units and symbol definitions.

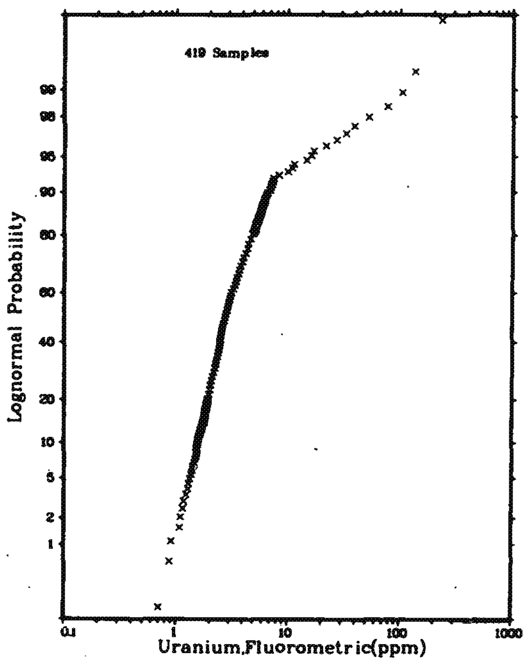
Table B-2

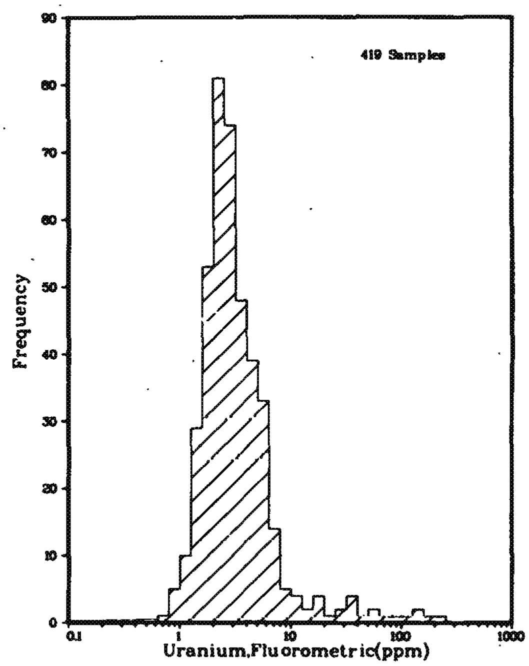
CORRELATION MATRIX FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

	LUFL	LUNT	L-SE	L-AS	L-V	L-TH	L-NB	L-K	L-NA	L-CA	L-SR	L-MG	L-BA	LUTU
LUFL	1.00 (419)													
LUNT	0.97*** 0.93*** (419)	1.00 (419)												
L-SE	0.61*** 0.47*** (400)	0.61*** 0.45*** (400)	1.00 (400)											
L-AS	0.61*** 0.63*** (418)	0.60*** 0.63*** (418)	0.47*** 0.33*** (400)	1.00 (418)										
L-V	0.68*** 0.58*** (419)	0.66*** 0.69*** (419)	0.41*** 0.28*** (400)	0.73*** 0.70*** (418)	1.00 (419)									
L-TH	0.33*** 0.42*** (393)	0.32*** 0.45*** (393)	0.14*** 0.13** ([illegible])	0.41*** 0.48*** (393)	0.57*** 0.62*** (393)	1.00 (393)								
L-NB	0.11** 0.19*** (318)	0.09* 0.17*** (318)	0.12** 0.13** (303)	0.08 0.08 (317)	0.26*** 0.32*** (318)	0.42*** 0.29*** (310)	1.00 (318)							
L-K	-0.03 0.32 (419)	-0.06 -0.00 (419)	-0.13*** -0.16*** (400)	0.18*** 0.18*** (418)	0.45*** 0.44*** (419)	0.23*** 0.23*** (393)	0.11** 0.30*** (318)	1.00 (419)						
L-NA	-0.08 -0.02 (407)	-0.11** -0.03 (407)	-0.15*** -0.15*** (389)	0.14*** 0.14*** (406)	0.30*** 0.29*** (407)	0.19*** 0.19*** (386)	-0.08 0.01 (318)	0.78*** 0.76*** (407)	1.00 (407)					
L-CA	-0.23*** -0.17*** (419)	-0.27*** -0.21*** (419)	-0.19*** -0.17*** (400)	-0.04 -0.02 (418)	0.01 0.01 (419)	-0.08 -0.07 (393)	0.17*** 0.24*** (318)	0.56*** 0.56*** (419)	0.58*** 0.59*** (407)	1.00 (419)				
L-SR	-0.06 0.08 (419)	-0.10** 0.04 (419)	-0.16*** -0.15*** (400)	0.16*** 0.24*** (418)	0.23*** 0.32*** (419)	0.09* 0.16*** (393)	0.15*** 0.28*** (318)	0.62*** 0.69*** (419)	0.67*** 0.72*** (407)	0.83*** 0.85*** (419)	1.00 (419)			
L-MG	-0.19*** -0.11** (419)	-0.22*** -0.14*** (419)	-0.24*** -0.24*** (400)	-0.01 0.06 (418)	0.16*** 0.22*** (419)	0.06 0.09* (393)	0.11* 0.21*** (318)	0.77*** 0.82*** (419)	0.67*** 0.73*** (407)	0.83*** 0.83*** (419)	0.86*** 0.87*** (419)	1.00 (419)		
L-BA	0.00 0.20*** (419)	-0.03 0.20*** (419)	-0.05 0.01 (400)	0.21*** 0.33*** (418)	0.33*** 0.42*** (419)	0.18*** 0.27*** (393)	-0.03 0.09 (318)	0.55*** 0.51*** (419)	0.51*** 0.53*** (407)	0.34*** 0.37*** (419)	0.38*** 0.50*** (419)	0.36*** 0.43*** (419)	1.00 (419)	
LUTU	-0.33 0.33*** (419)	-0.15*** 0.10** (419)	0.01 0.12** (400)	0.21*** 0.25*** (418)	0.10* 0.21*** (419)	0.02 0.10** (393)	0.06 0.16*** (318)	0.18*** 0.14*** (419)	0.15*** 0.13** (407)	0.16*** 0.08* (419)	0.16*** 0.13*** (419)	0.10* 0.06 (419)	0.13** 0.14*** (419)	1.00 (419)
L-CO	0.26*** 0.40*** (364)	0.27*** 0.45*** (364)	0.13** 0.13** (347)	0.40*** 0.45*** (363)	0.57*** 0.69*** (364)	0.48*** 0.46*** (351)	0.28*** 0.21*** (308)	0.20*** 0.25*** (364)	0.07 0.07 (363)	-0.13** -0.11** (364)	0.11** 0.14*** (364)	0.07 0.09* (364)	0.07 0.11** (364)	0.01 0.04 (364)
L-MN	0.05 0.12** (419)	0.03 0.12** (419)	-0.05 -0.11** (400)	0.32*** 0.28*** (418)	0.42*** 0.42*** (419)	0.26*** 0.25*** (393)	-0.06 0.01 (318)	0.62*** 0.62*** (419)	0.60*** 0.60*** (407)	0.45*** 0.44*** (419)	0.35*** 0.38*** (419)	0.50*** 0.61*** (419)	0.40*** 0.34*** (419)	0.15*** 0.08* (419)
L-P	0.16*** 0.34*** (419)	0.12** 0.32*** (419)	-0.00 0.03 (400)	0.37*** 0.41*** (418)	0.65*** 0.70*** (419)	0.37*** 0.40*** (393)	0.15*** 0.30*** (318)	0.77*** 0.66*** (419)	0.73*** 0.61*** (407)	0.48*** 0.40*** (419)	0.57*** 0.62*** (419)	0.53*** 0.56*** (419)	0.57*** 0.62*** (419)	0.16*** 0.21*** (419)
L-ZN	0.26*** 0.48*** (419)	0.23*** 0.48*** (419)	0.07 0.09* (400)	0.51*** 0.58*** (418)	0.78*** 0.85*** (419)	0.50*** 0.55*** (393)	0.25*** 0.36*** (318)	0.71*** 0.61*** (419)	0.58*** 0.49*** (407)	0.20*** 0.23*** (419)	0.60*** 0.52*** (419)	0.41*** 0.44*** (419)	0.55*** 0.58*** (419)	0.13*** 0.20*** (419)
L-B	0.16*** 0.30*** (406)	0.13*** 0.30*** (406)	0.04 0.04 (389)	0.30*** 0.36*** (405)	0.64*** 0.69*** (406)	0.37*** 0.37*** (381)	0.40*** 0.47*** (308)	0.68*** 0.69*** (406)	0.47*** 0.40*** (396)	0.35*** 0.35*** (406)	0.49*** 0.57*** (406)	0.52*** 0.55*** (406)	0.39*** 0.43*** (406)	0.07 0.14*** (406)
L-CU	0.33*** 0.52*** (419)	0.30*** 0.54*** (419)	0.11** 0.12** (400)	0.54*** 0.64*** (418)	0.82*** 0.88*** (419)	0.55*** 0.58*** (393)	0.32*** 0.35*** (318)	0.63*** 0.56*** (419)	0.44*** 0.37*** (407)	0.17*** 0.16*** (419)	0.41*** 0.46*** (419)	0.30*** 0.38*** (419)	0.45*** [illegible] (419)	0.10** 0.20*** (419)
L-NI	0.31*** 0.49*** (419)	0.28*** 0.50*** (419)	0.09* 0.11** (400)	0.56*** 0.64*** (418)	0.79*** 0.85*** (419)	0.50*** 0.59*** (393)	0.31*** 0.34*** (318)	0.65*** 0.58*** (419)	0.51*** 0.43*** (407)	0.28*** 0.25*** (419)	0.49*** 0.63*** (419)	0.45*** 0.46*** (419)	0.60*** 0.62*** (419)	0.07 0.16*** (419)
L-FE	0.31*** 0.49*** (419)	0.28*** 0.50*** (419)	0.12** 0.11** (400)	0.56*** 0.60*** (418)	0.79*** 0.88*** (419)	0.51*** 0.58*** (393)	0.14** 0.25*** (318)	0.64*** 0.59*** (419)	0.50*** 0.44*** (407)	0.18*** 0.14*** (419)	0.41*** 0.46*** (419)	0.40*** 0.42*** (419)	0.43*** 0.47*** (419)	0.13*** 0.19*** (419)
L-AL	0.27*** 0.46*** (419)	0.24*** 0.47*** (419)	0.06 0.07 (400)	0.44*** 0.54*** (418)	0.79*** 0.86*** (419)	0.49*** 0.53*** (393)	0.16*** 0.29*** (318)	0.76*** 0.65*** (419)	0.51*** 0.41*** (407)	0.17*** 0.13** (419)	0.39*** 0.46*** (419)	0.44*** [illegible] (419)	0.51*** 0.51*** (419)	0.08* 0.17*** (419)
L-CR	0.35*** 0.53*** (419)	0.32*** 0.54*** (419)	0.11** 0.11** (400)	0.53*** 0.62*** (418)	0.84*** 0.90*** (419)	0.58*** 0.61*** (393)	0.30*** 0.34*** (318)	0.68*** 0.59*** (419)	0.40*** 0.37*** (407)	0.14*** 0.10** (419)	0.40*** 0.44*** (419)	0.39*** 0.36*** (419)	0.39*** 0.41*** (419)	0.08 0.18*** (419)
L-SC	0.29*** 0.46*** (419)	0.27*** 0.49*** (419)	0.07 0.06 (400)	0.43*** 0.53*** (418)	0.77*** 0.84*** (419)	0.56*** 0.56*** (393)	0.28*** 0.31*** (318)	0.62*** 0.55*** (419)	0.36*** 0.28*** (407)	0.08 0.03 (419)	0.33*** 0.37*** (419)	0.38*** 0.36*** (419)	0.35*** 0.33*** (419)	0.03 0.11** (419)
L-TI	0.35*** 0.51*** (419)	0.34*** 0.55*** (419)	0.13*** 0.11** (400)	0.47*** 0.53*** (418)	0.78*** 0.84*** (419)	0.54*** 0.55*** (393)	0.17*** 0.23*** (318)	0.62*** 0.50*** (419)	0.36*** 0.25*** (407)	-0.01 -0.07 (419)	0.21*** 0.24*** (419)	0.27*** 0.23*** (419)	0.34*** 0.32*** (419)	0.05 0.13*** (419)
L-LI	0.30*** 0.42*** (419)	0.28*** 0.42*** (419)	0.05 0.00 (400)	0.42*** 0.48*** (418)	0.71*** 0.74*** (419)	0.44*** 0.43*** (393)	0.12** 0.14** (318)	0.66*** 0.56*** (419)	0.41*** 0.33*** (407)	0.19*** 0.16*** (419)	0.44*** 0.45*** (419)	0.40*** 0.44*** (419)	0.25*** 0.21*** (419)	0.05 0.12** (419)
L-CE	0.32*** 0.51*** (419)	0.33*** 0.57*** (419)	0.12** 0.12** (400)	0.43*** 0.50*** (418)	0.67*** 0.73*** (419)	0.56*** 0.58*** (393)	0.11** 0.13** (318)	0.34*** 0.23*** (419)	0.10** 0.03 (407)	-0.26*** -0.27*** (419)	-0.01 0.05 (419)	0.02 0.00 (419)	0.30*** 0.28*** (419)	-0.02 0.00 (419)
L-Y	0.24*** 0.40*** (419)	0.24*** 0.42*** (419)	0.07 0.11** (400)	0.33*** 0.41*** (418)	0.61*** 0.65*** (419)	0.43*** 0.45*** (393)	0.14** 0.19*** (318)	0.39*** 0.27*** (419)	0.13*** 0.03 (407)	-0.11** -0.10** (419)	0.10** 0.13*** (419)	0.16*** 0.13** (419)	0.38*** 0.30*** (419)	0.01 0.11** (419)
L-ZR	0.32*** 0.42*** (419)	0.30*** 0.43*** (419)	0.08 0.04 (400)	0.40*** 0.42*** (418)	0.64*** 0.65*** (419)	0.47*** 0.48*** (393)	0.13** 0.13** (318)	0.57*** 0.43*** (419)	0.32*** 0.20*** (407)	-0.00 -0.05 (419)	0.24*** 0.25*** (419)	0.31*** 0.27*** (419)	0.30*** 0.24*** (419)	0.07 0.15*** (419)

NOTE: (1) Pearson correlation/Spearman correlation/(sample size). If either element has a concentration below the laboratory detection limits, it is omitted from the pairwise computations.
(2) Significance levels: *-10%, **-5%, ***-1%.

	L-CO	L-MN	L-P	L-ZN	L-B	L-CU	L-NI	L-FE	L-AL	L-CA	L-SC	L-TI	L-LI	L-CE	L-Y	L-ZR
L-CO	1.00 (364)															
L-MN	0.60*** 0.58*** (364)	1.00 (419)														
L-P	0.35*** 0.40*** (364)	0.70*** 0.59*** (419)	1.00 (419)													
L-ZN	0.61*** 0.65*** (364)	0.68*** 0.60*** (419)	0.90*** 0.89*** (419)	1.00 (419)												
L-B	0.55*** 0.57*** (355)	0.59*** 0.58*** (406)	0.75*** 0.76*** (406)	0.81*** 0.81*** (406)	1.00 (406)											
L-CU	0.68*** 0.76*** (364)	0.56*** 0.54*** (419)	0.70*** 0.70*** (419)	0.90*** 0.90*** (419)	0.77*** 0.77*** (406)	1.00 (419)										
L-NI	0.80*** 0.83*** (364)	0.68*** 0.63*** (419)	0.74*** 0.71*** (419)	0.87*** 0.87*** (419)	0.74*** 0.75*** (406)	0.90*** 0.92*** (419)	1.00 (419)									
L-FE	0.69*** 0.79*** (364)	0.70*** 0.64*** (419)	0.78*** 0.76*** (419)	0.88*** 0.90*** (419)	0.72*** 0.70*** (406)	0.83*** 0.89*** (419)	0.86*** 0.89*** (419)	1.00 (419)								
L-AL	0.60*** 0.69*** (364)	0.61*** 0.57*** (419)	0.81*** 0.79*** (419)	0.90*** 0.91*** (419)	0.79*** 0.80*** (406)	0.90*** 0.92*** (419)	0.85*** 0.86*** (419)	0.87*** 0.91*** (419)	1.00 (419)							
L-CA	0.72*** 0.78*** (364)	0.60*** 0.55*** (419)	0.76*** 0.72*** (419)	0.83*** 0.89*** (419)	0.78*** 0.78*** (406)	0.93*** 0.94*** (419)	0.92*** 0.93*** (419)	0.87*** 0.92*** (419)	0.94*** 0.94*** (419)	1.00 (419)						
L-SC	0.72*** 0.79*** (364)	0.56*** 0.55*** (419)	0.67*** 0.66*** (419)	0.83*** 0.82*** (419)	0.72*** 0.73*** (406)	0.91*** 0.91*** (419)	0.88*** 0.80*** (419)	0.82*** 0.87*** (419)	0.92*** 0.93*** (419)	0.92*** 0.93*** (419)	1.00 (419)					
L-TI	0.65*** 0.74*** (364)	0.54*** 0.51*** (419)	0.65*** 0.59*** (419)	0.78*** 0.77*** (419)	0.66*** 0.66*** (406)	0.82*** 0.84*** (419)	0.81*** 0.81*** (419)	0.81*** 0.80*** (419)	0.90*** 0.89*** (419)	0.90*** 0.90*** (419)	0.88*** 0.90*** (419)	1.00 (419)				
L-LI	0.72*** 0.77*** (364)	0.62*** 0.62*** (419)	0.64*** 0.56*** (419)	0.76*** 0.72*** (419)	0.69*** 0.68*** (406)	0.82*** 0.81*** (419)	0.83*** 0.85*** (419)	0.79*** 0.82*** (419)	0.86*** 0.83*** (419)	0.86*** 0.87*** (419)	0.87*** 0.87*** (419)	0.84*** 0.83*** (419)	1.00 (419)			
L-CE	0.60*** 0.60*** (364)	0.34*** 0.31*** (419)	0.44*** 0.44*** (419)	0.63*** 0.60*** (419)	0.48*** 0.49*** (406)	0.71*** 0.73*** (419)	0.60*** 0.67*** (419)	0.65*** 0.71*** (419)	0.76*** 0.77*** (419)	0.74*** 0.76*** (419)	0.80*** 0.80*** (419)	0.86*** 0.84*** (419)	0.65*** 0.66*** (419)	1.00 (419)		
L-Y	0.54*** 0.60*** (364)	0.39*** 0.33*** (419)	0.50*** 0.52*** (419)	0.65*** 0.60*** (419)	0.53*** 0.53*** (406)	0.71*** 0.71*** (419)	0.62*** 0.60*** (419)	0.63*** 0.60*** (419)	0.76*** 0.75*** (419)	0.68*** 0.68*** (419)	0.79*** 0.77*** (419)	0.72*** 0.71*** (419)	0.59*** 0.57*** (419)	0.83*** 0.81*** (419)	1.00 (419)	
L-ZR	0.51*** 0.57*** (364)	0.47*** 0.46*** (419)	0.56*** 0.47*** (419)	0.64*** 0.59*** (419)	0.55*** 0.55*** (406)	0.72*** 0.70*** (419)	0.68*** 0.65*** (419)	0.68*** 0.70*** (419)	0.80*** 0.74*** (419)	0.77*** 0.76*** (419)	0.79*** 0.78*** (419)	0.88*** 0.86*** (419)	0.76*** 0.74*** (419)	0.74*** 0.71*** (419)	0.74*** 0.72*** (419)	1.00 (419)





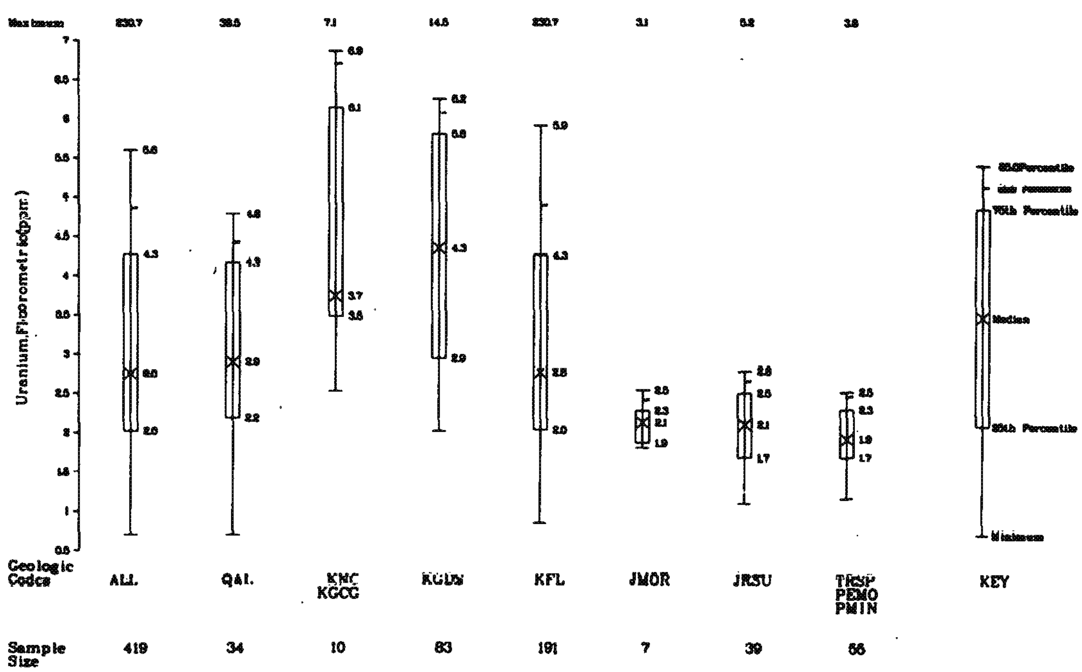
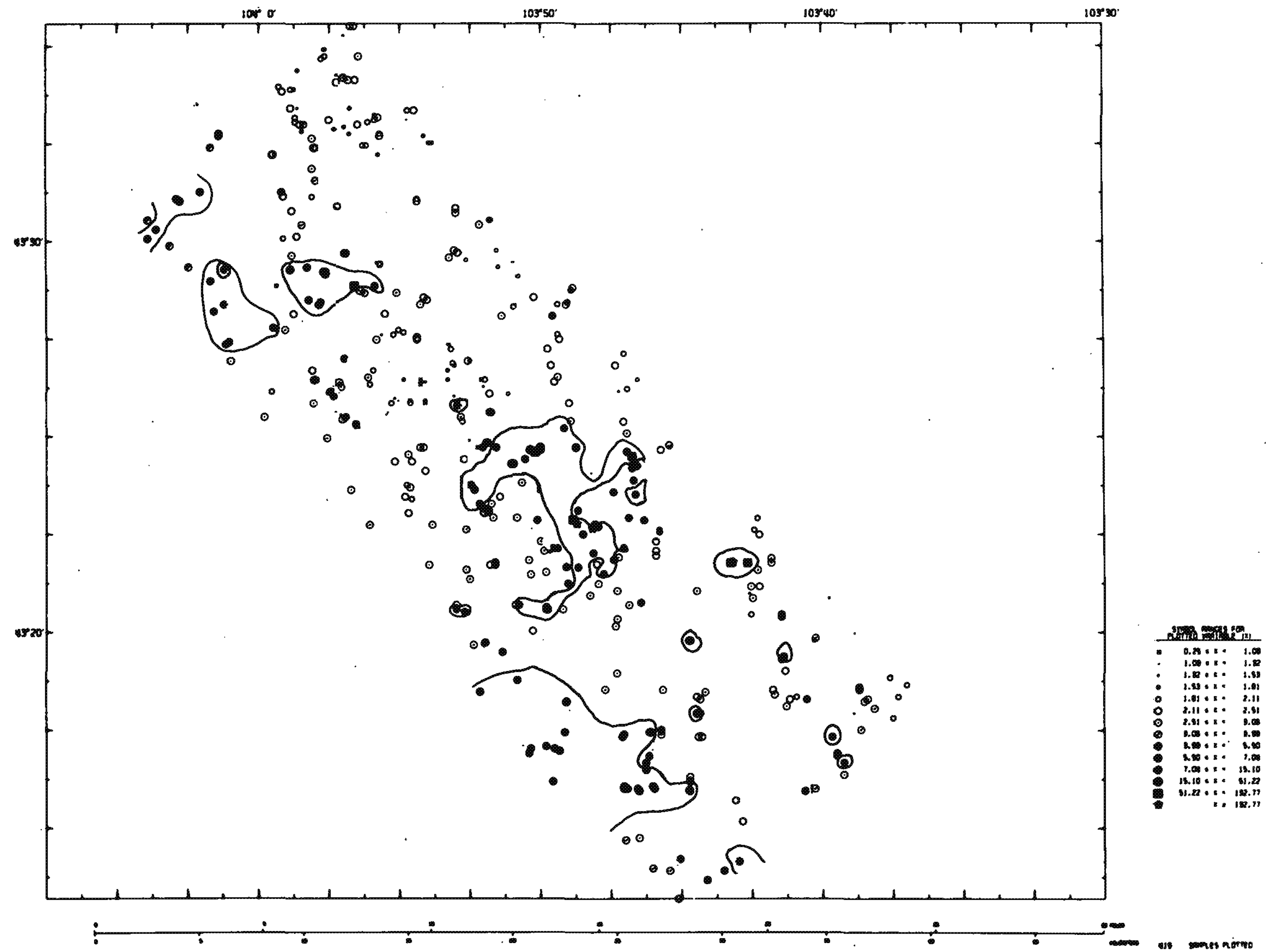


Figure B-1a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SOLUBLE URANIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤5.50 ppm

Figure B-1b

GEOCHEMICAL DISTRIBUTION OF SOLUBLE URANIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

B-13

ED_005364K_00000020-00100

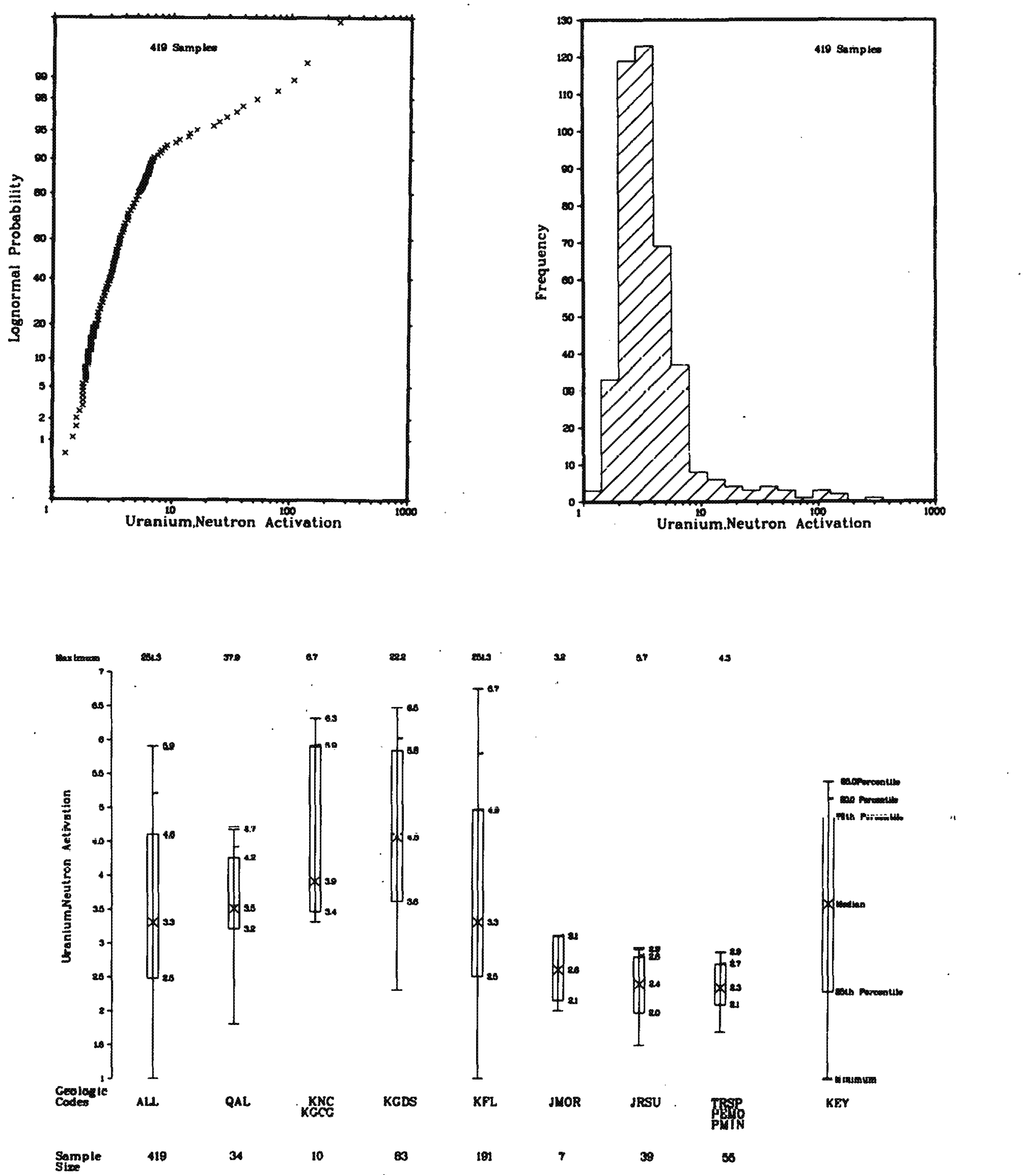
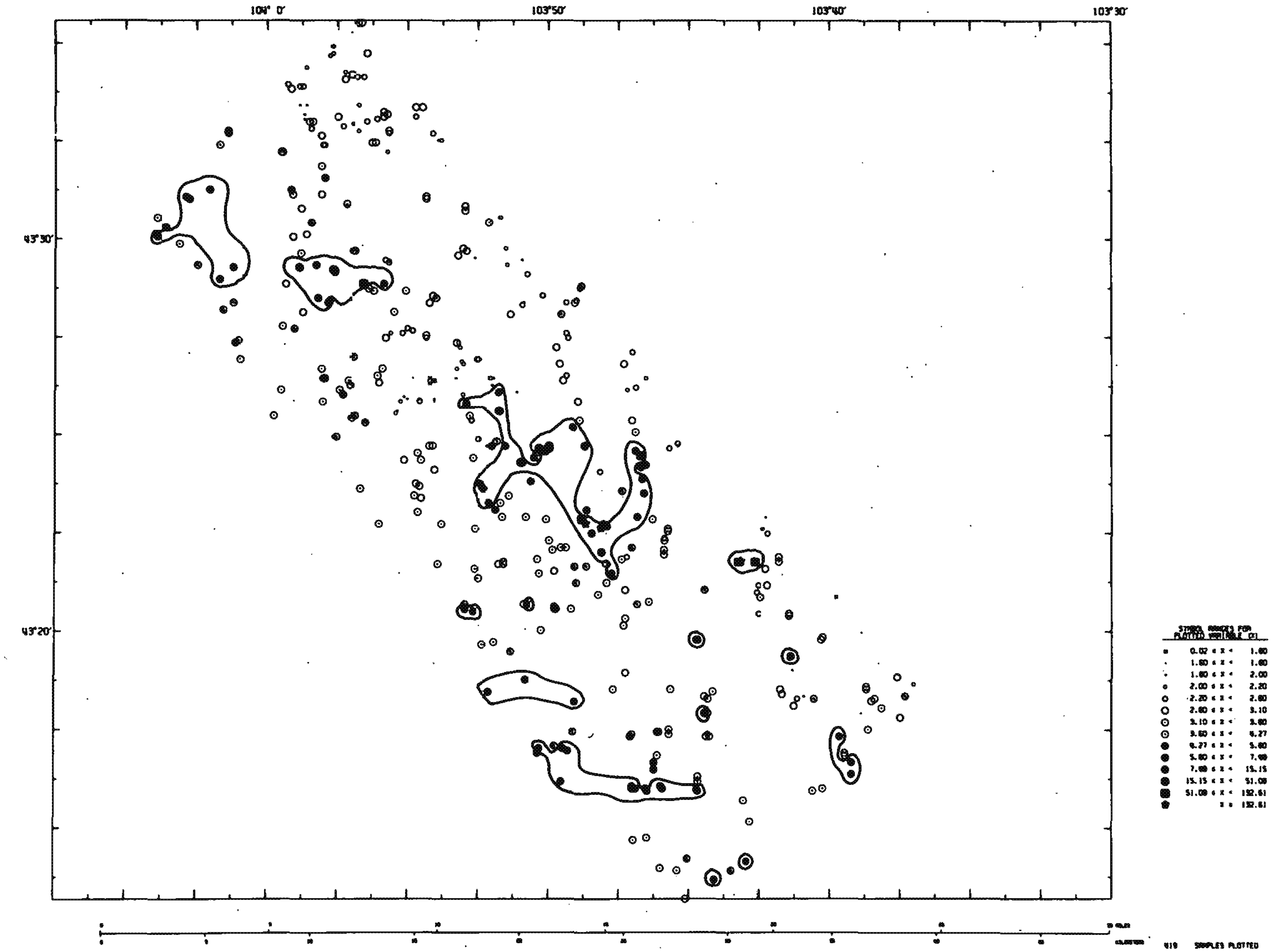


Figure B-2a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR URANIUM BY NEUTRON ACTIVATION IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤5.80 ppm

Figure B-2b

GEOCHEMICAL DISTRIBUTION OF URANIUM BY NEUTRON ACTIVATION IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

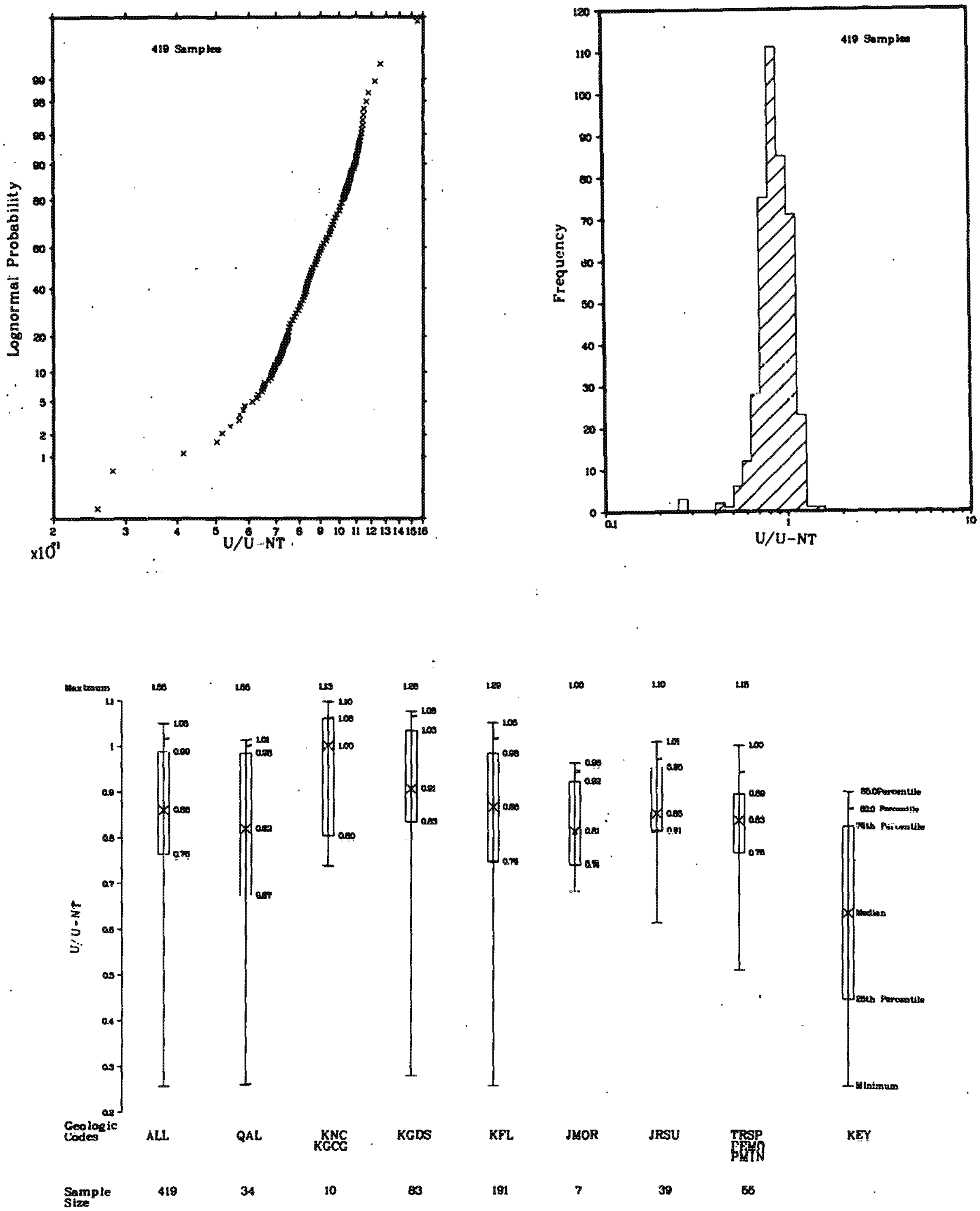
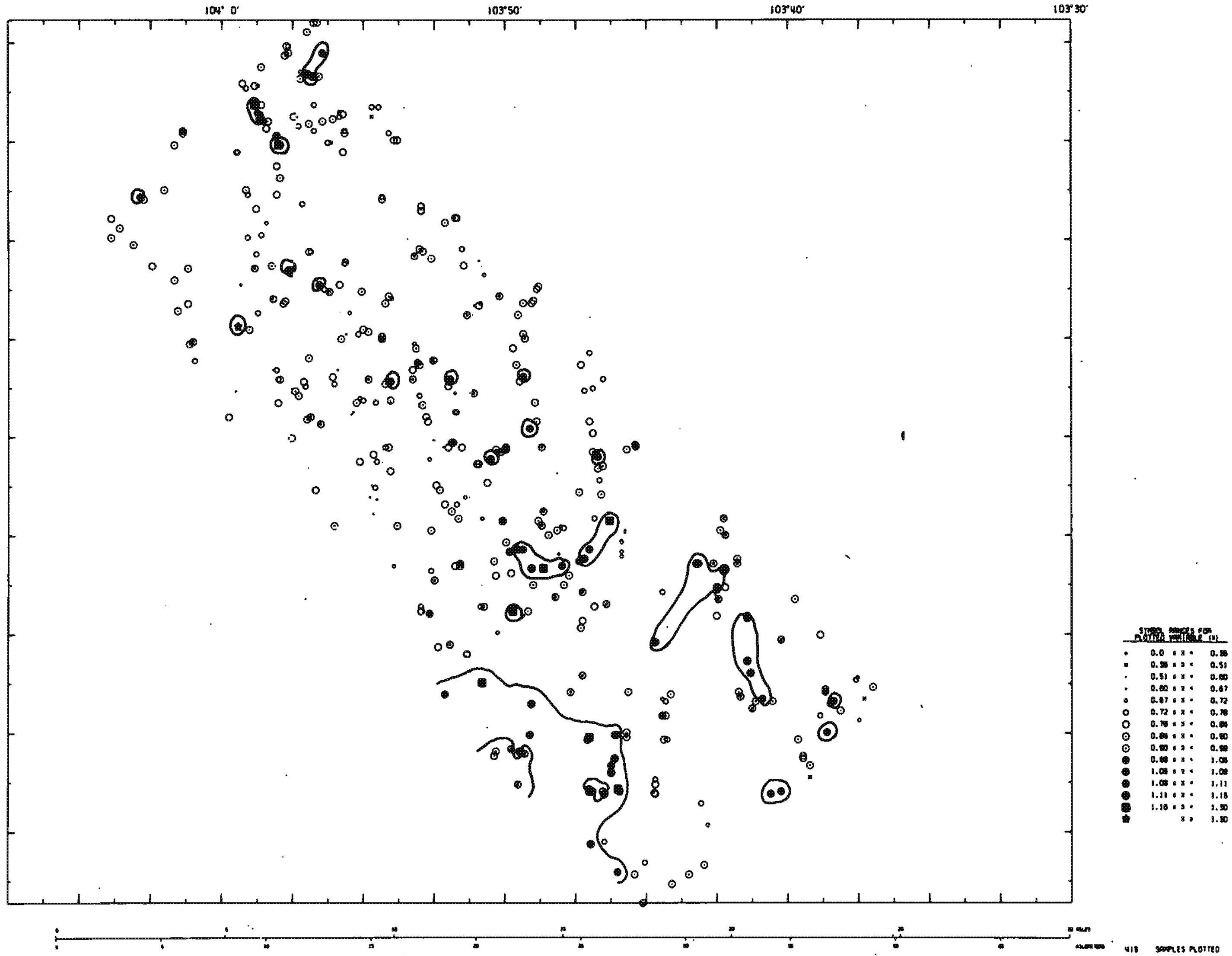


Figure B-3a

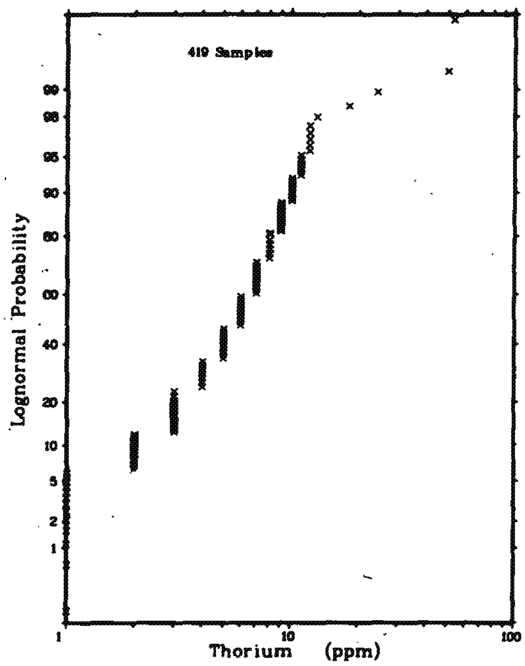
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR URANIUM FLUOROMETRIC/
URANIUM NEUTRON ACTIVATION IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

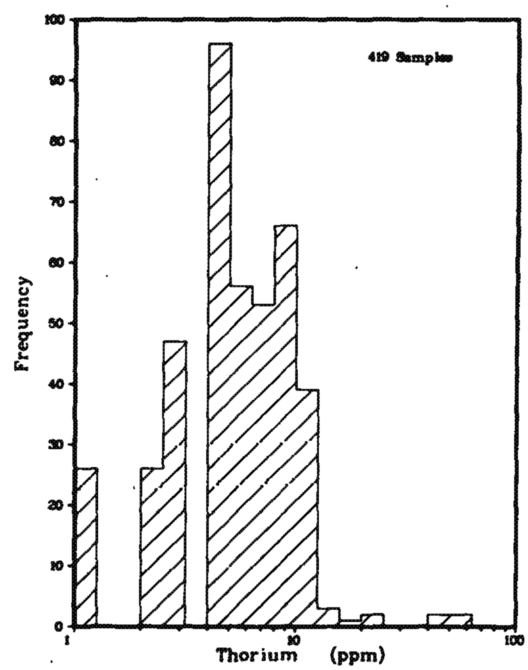


Approximate
Contour
≤1.06

Figure B-3b

GEOCHEMICAL DISTRIBUTION OF URANIUM FLUOROMETRIC/URANIUM NEUTRON ACTIVATION
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





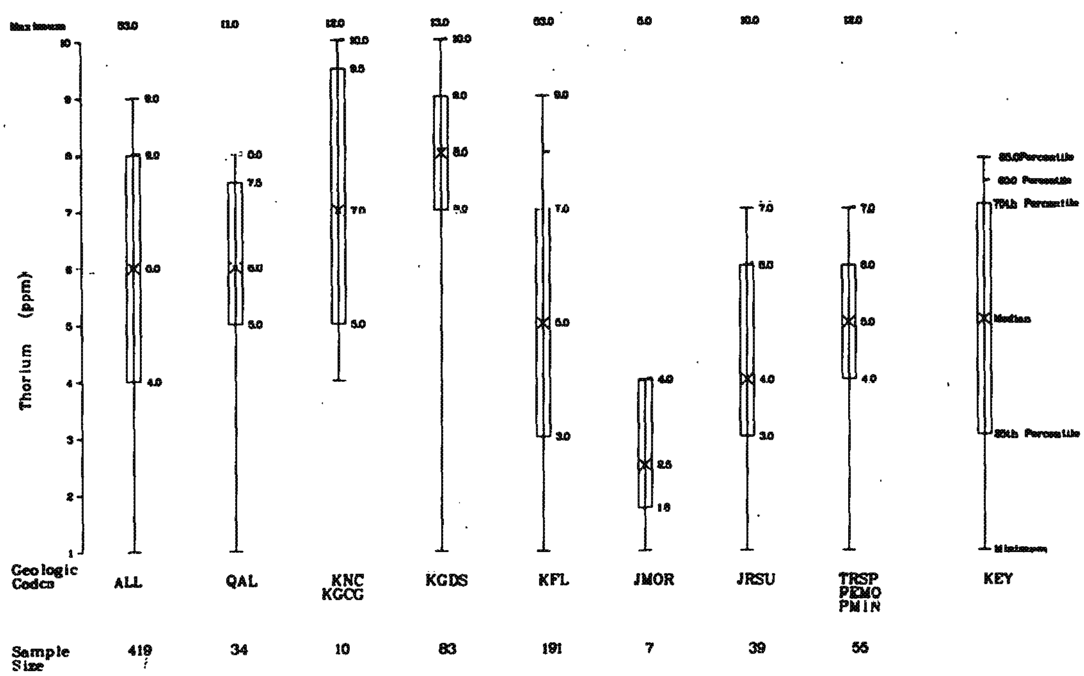
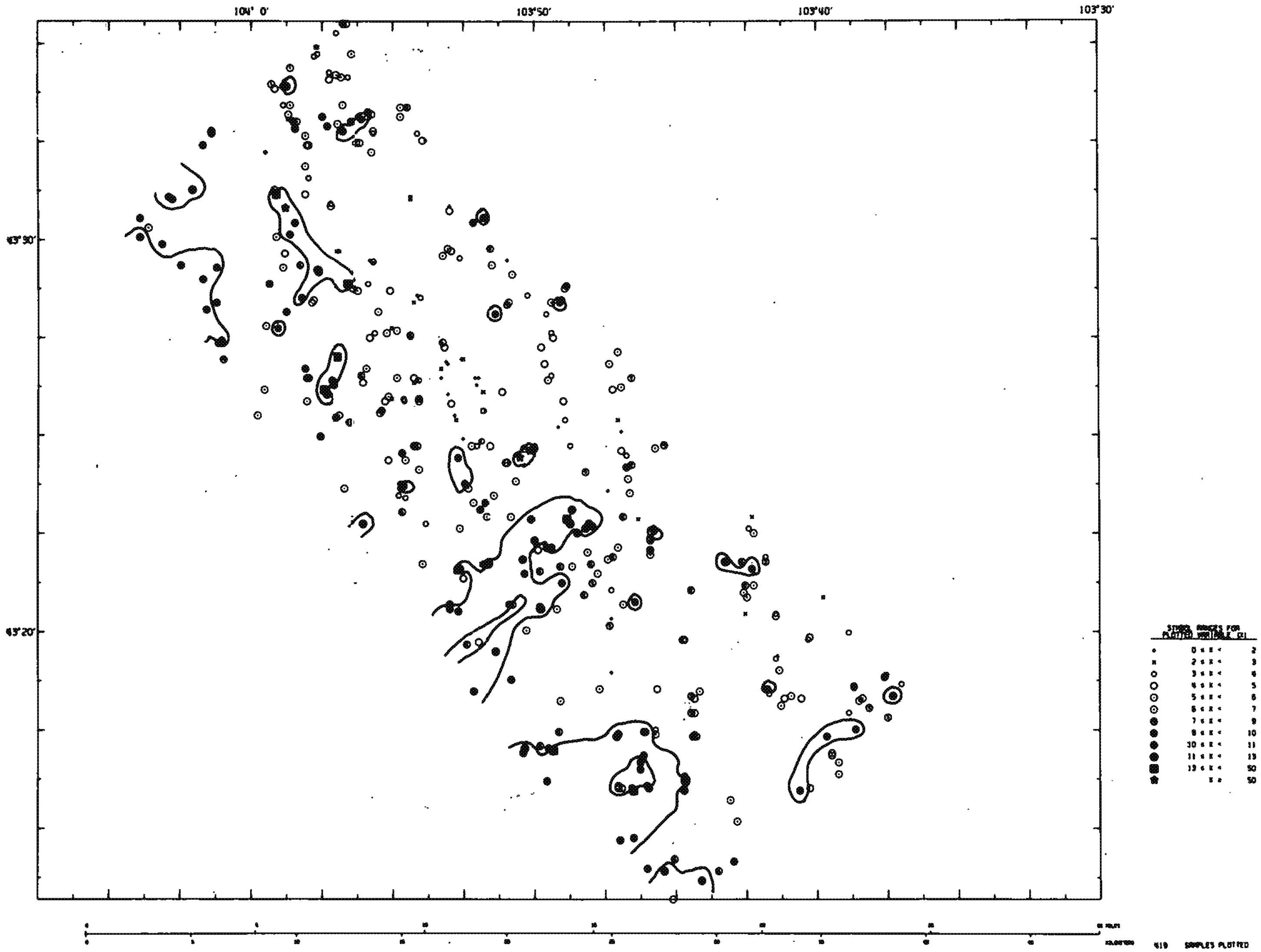


Figure B-4a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR THORIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤9 ppm

Figure B-4b

GEOCHEMICAL DISTRIBUTION OF THORIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

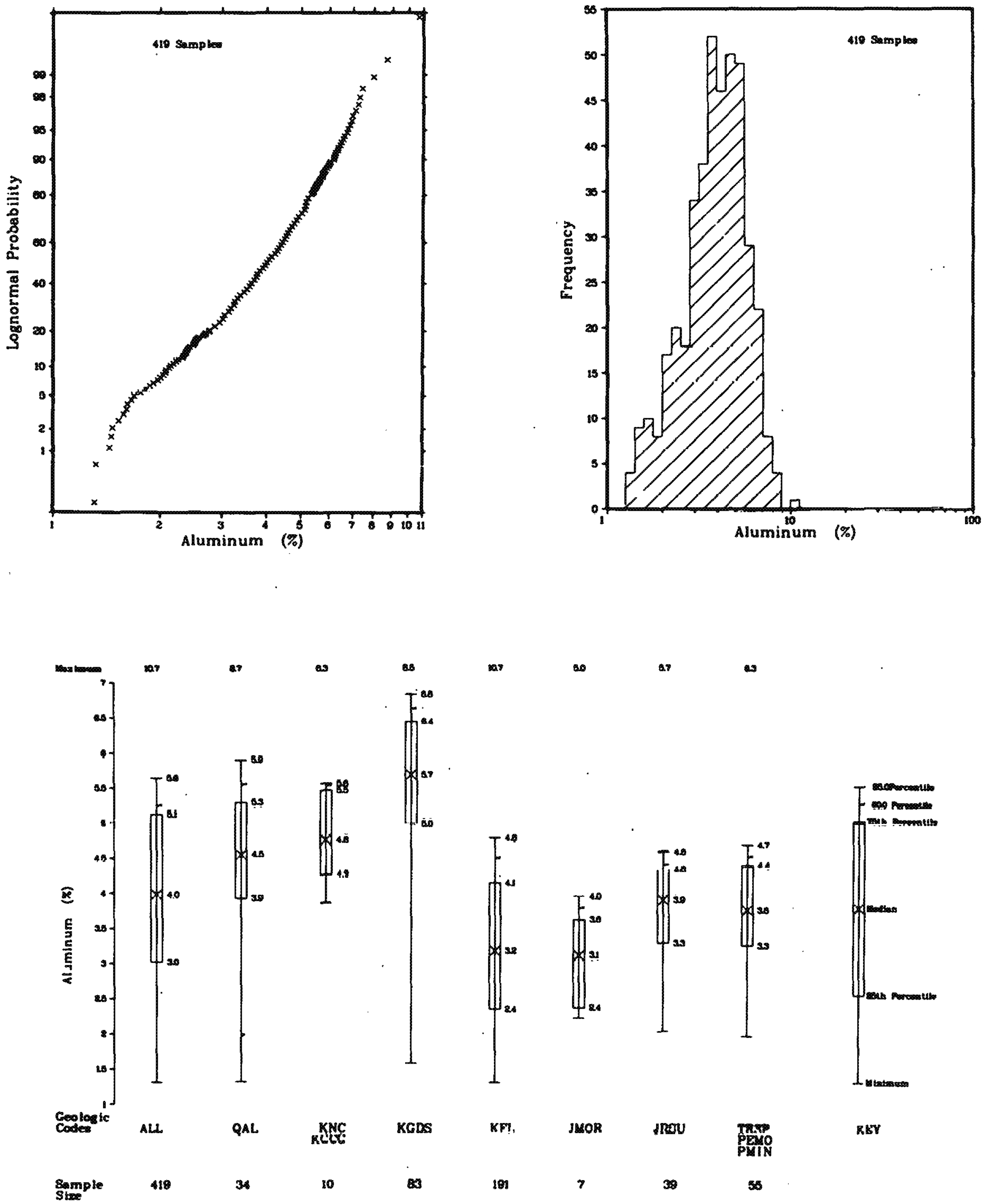
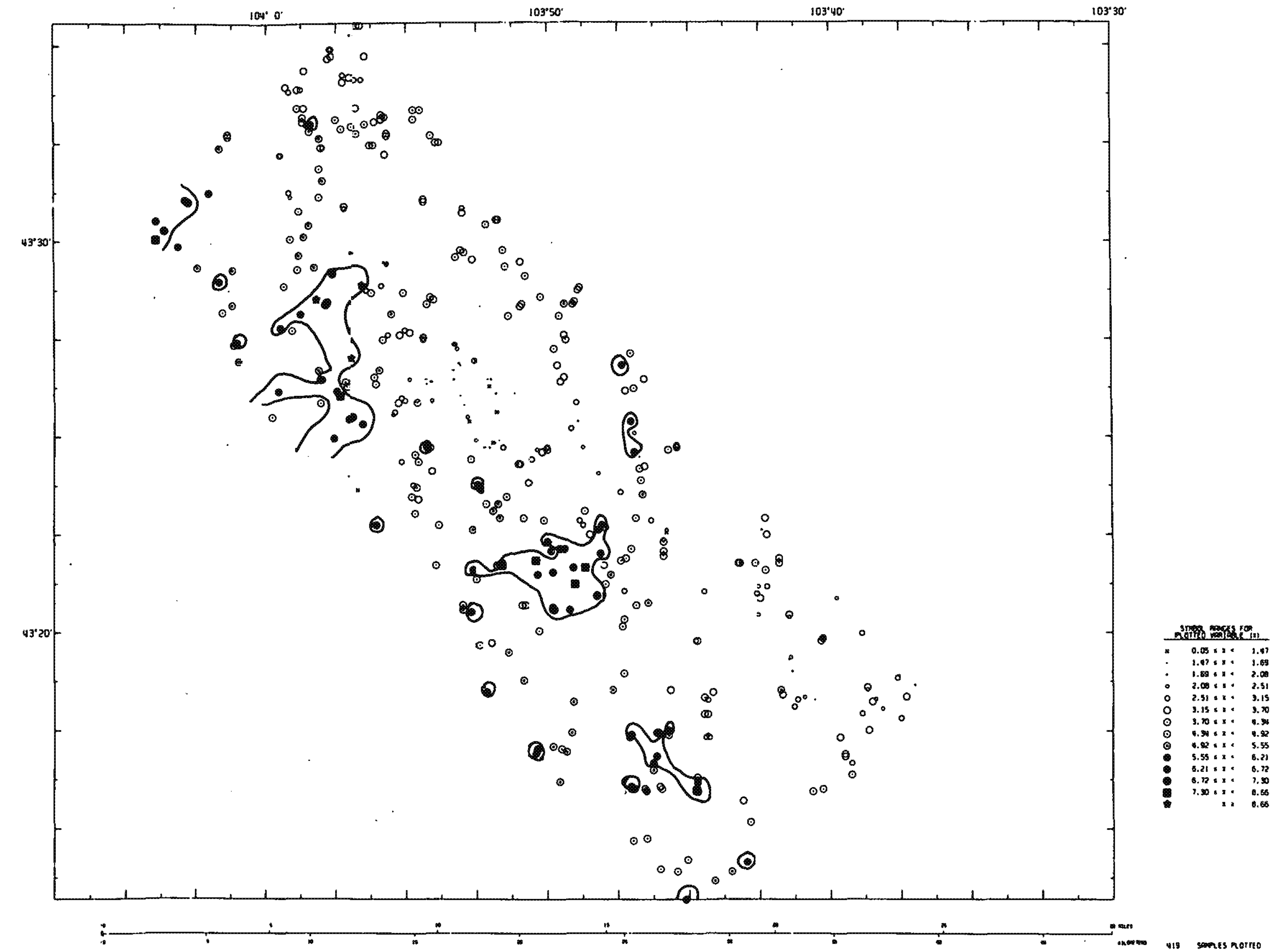


Figure B-5a

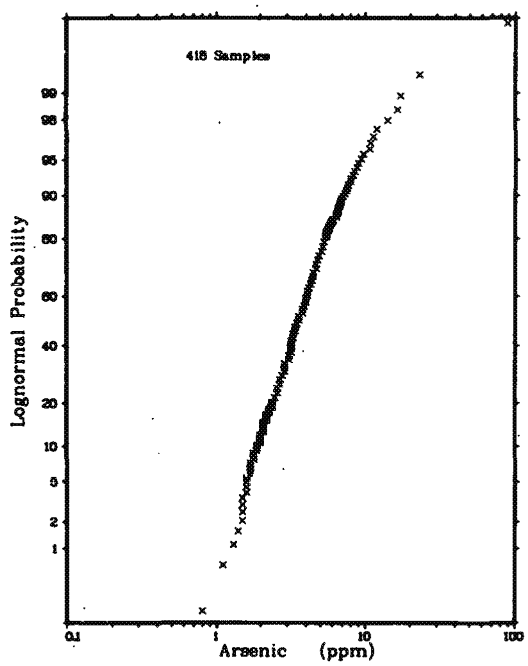
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ALUMINUM (%)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

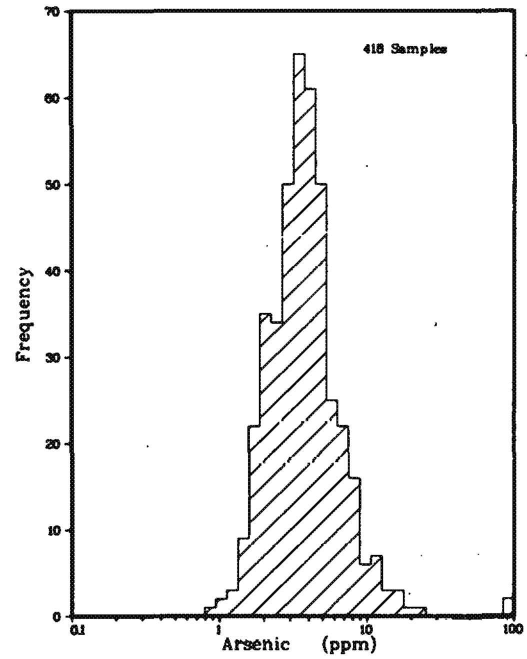


Approximate
Contour
≤5.55 %

Figure B-5b

GEOCHEMICAL DISTRIBUTION OF ALUMINUM (%) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





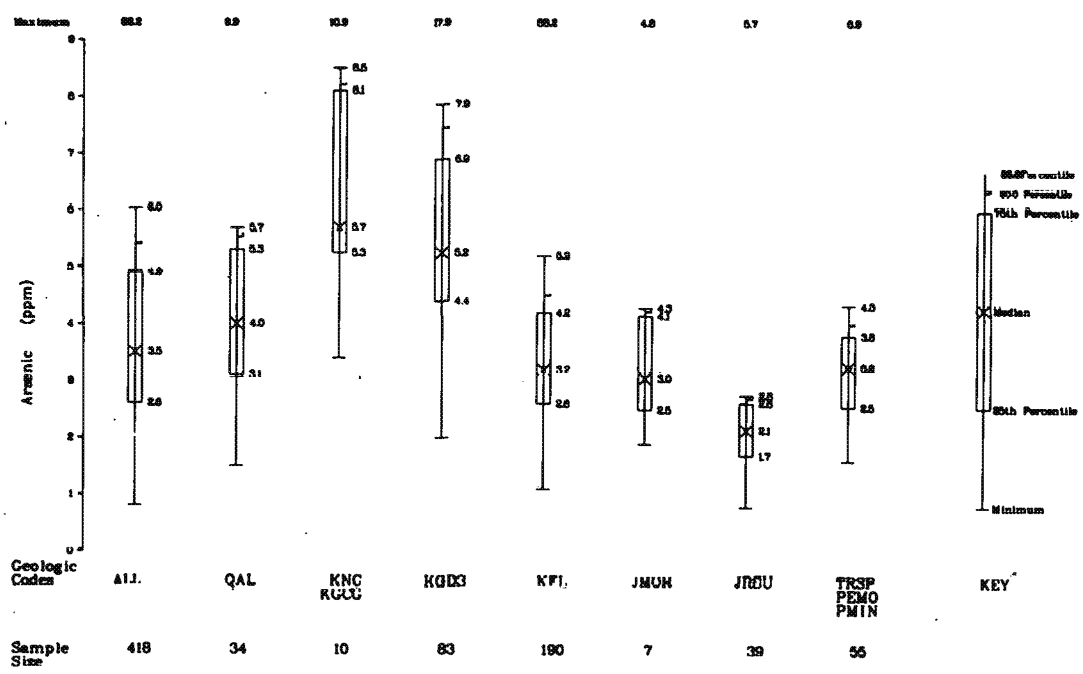


Figure B-6a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ARSENIC (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

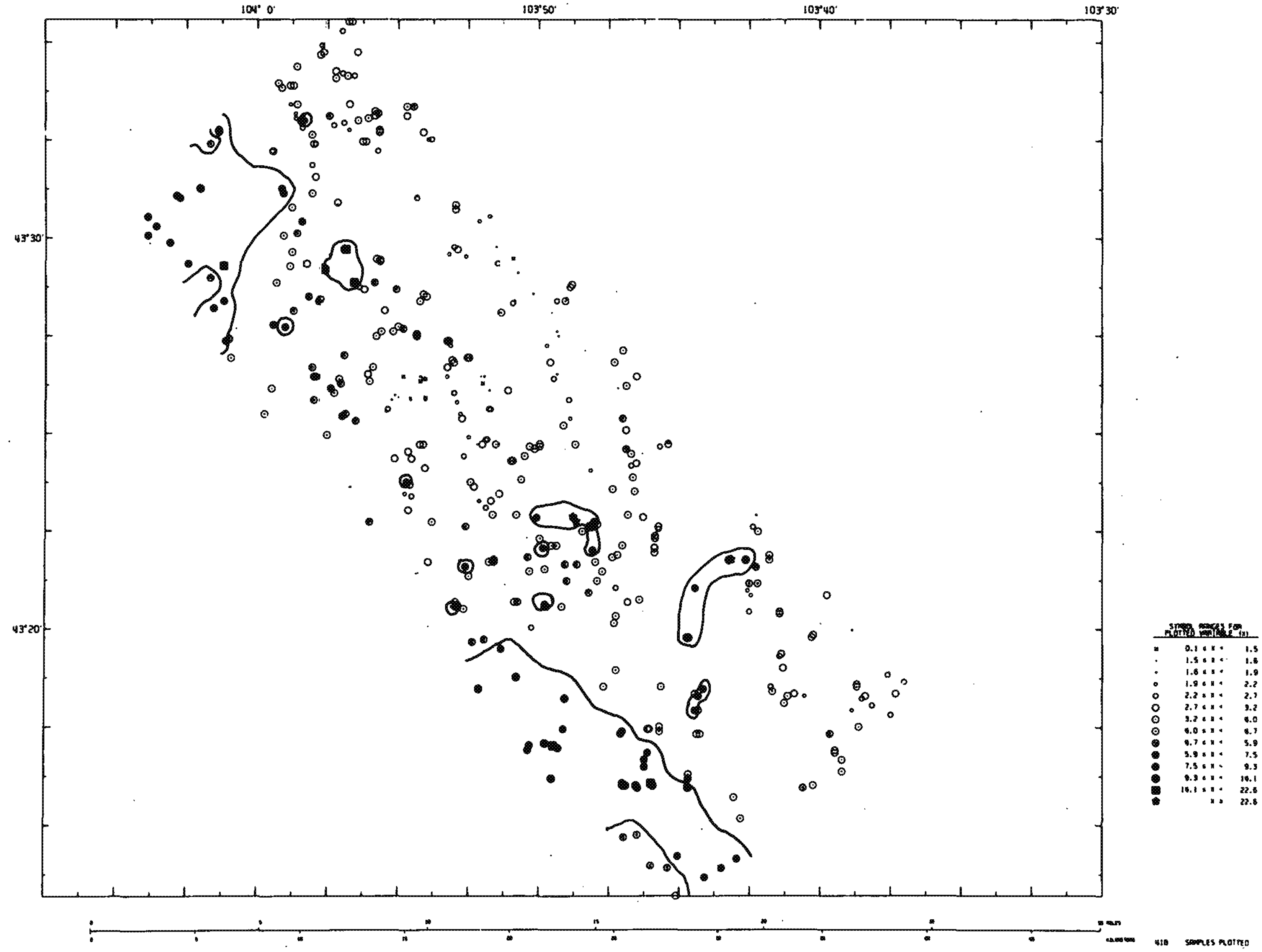


Figure B-6b

Approximate
Contour
≤5.9 ppm

GEOCHEMICAL DISTRIBUTION OF ARSENIC (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

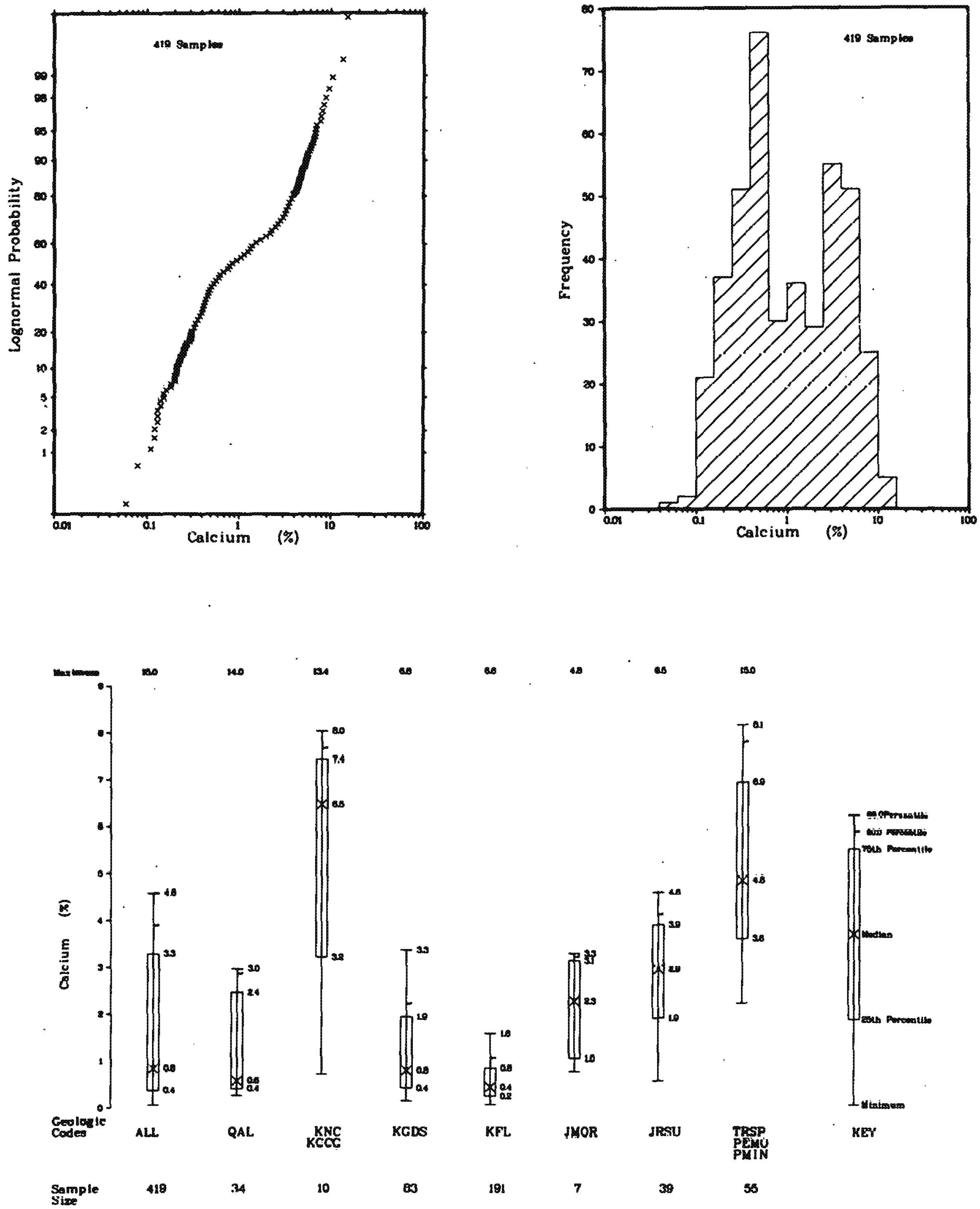
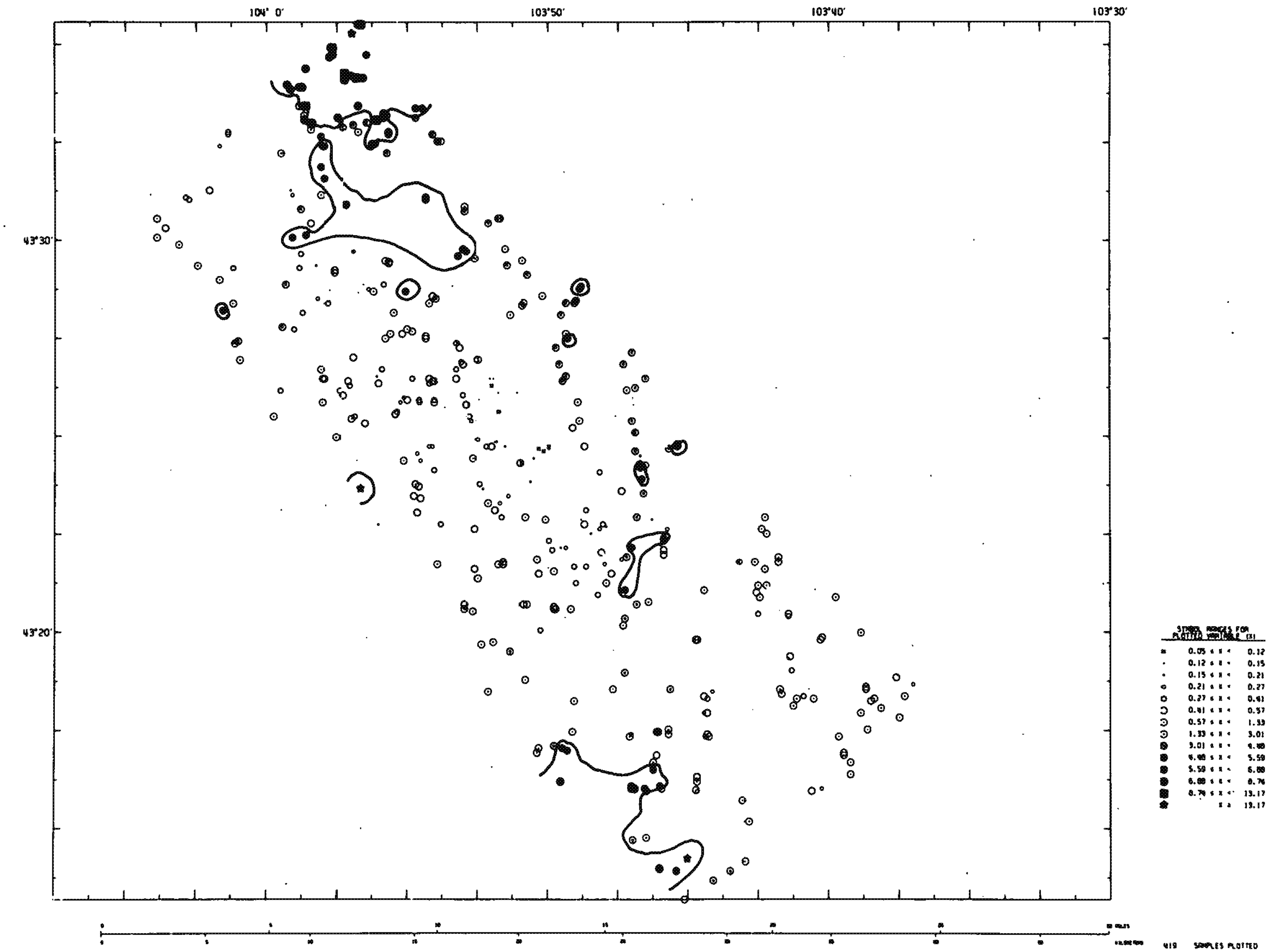


Figure B-7a

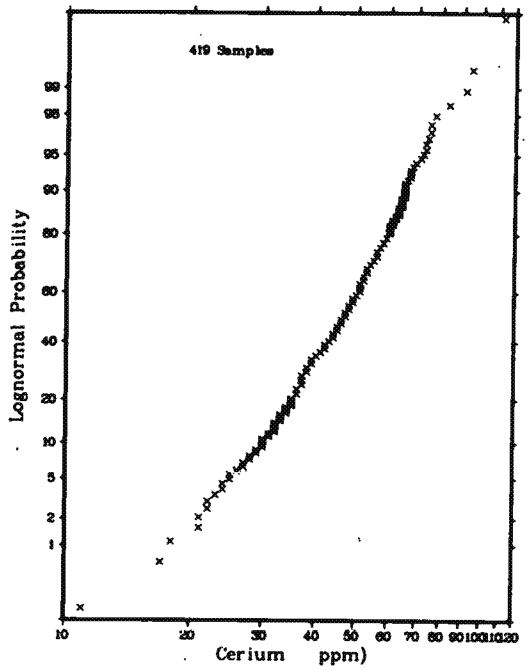
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR CALCIUM (%)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

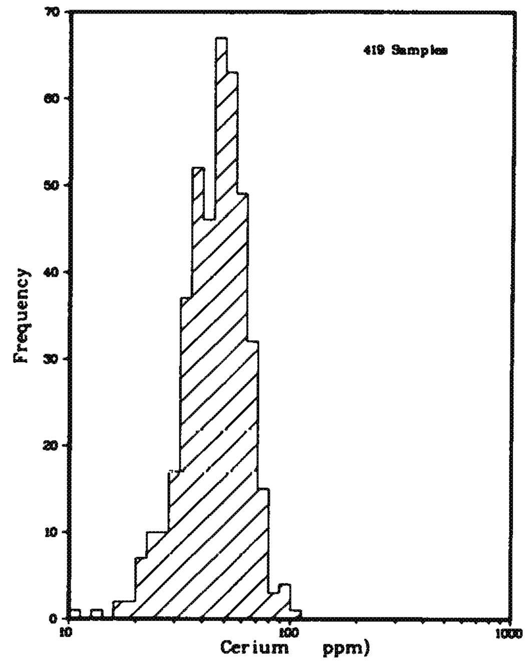


Approximate
Contour
≤4.48%

Figure B-7b

GEOCHEMICAL DISTRIBUTION OF CALCIUM (%) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





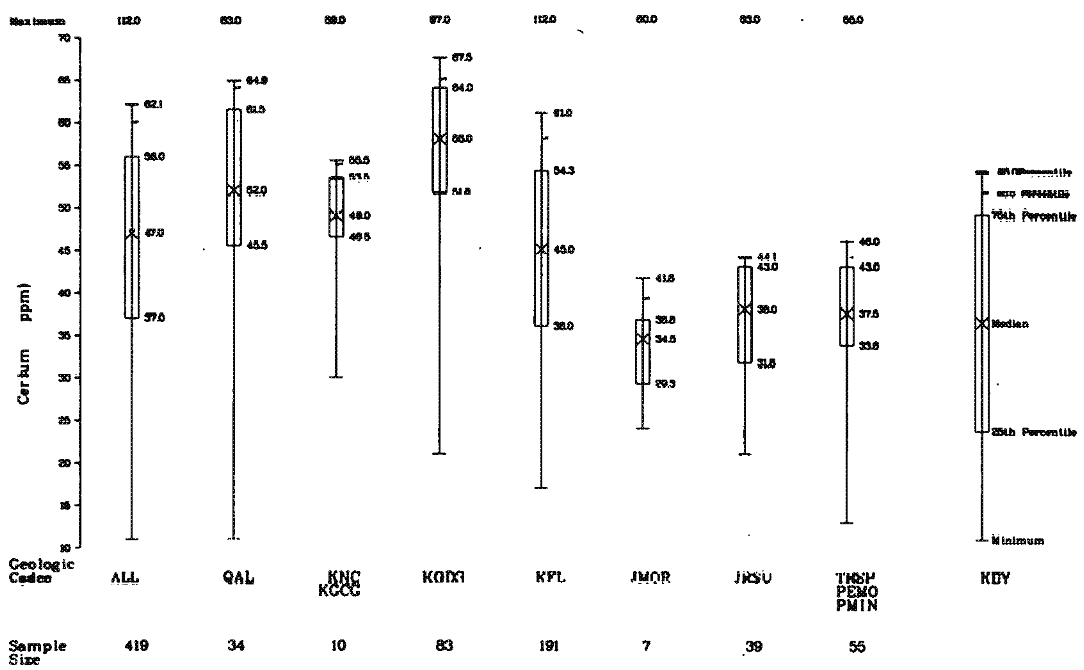
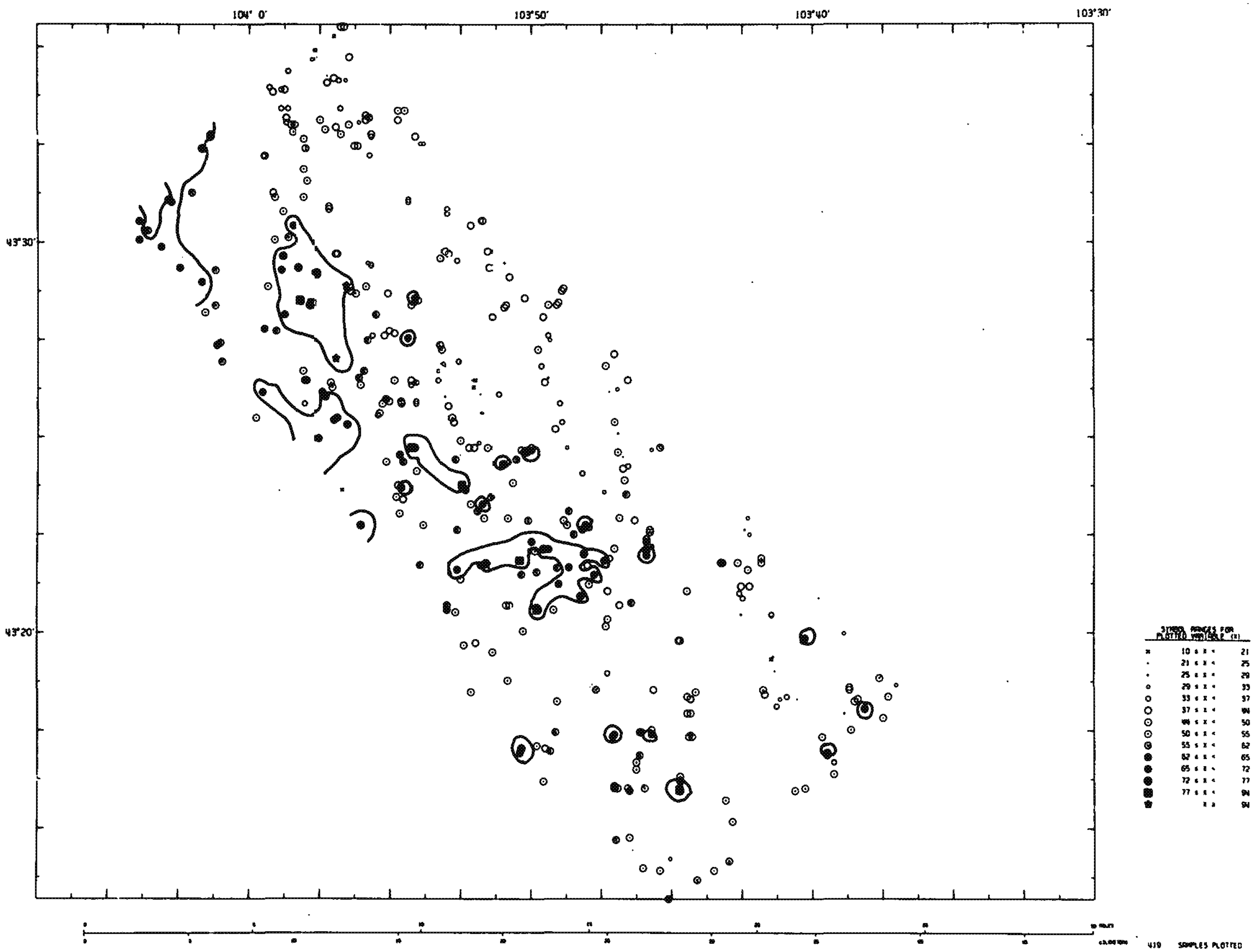


Figure B-8a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR CERIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤62 ppm

Figure B-8b

GEOCHEMICAL DISTRIBUTION OF CERIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

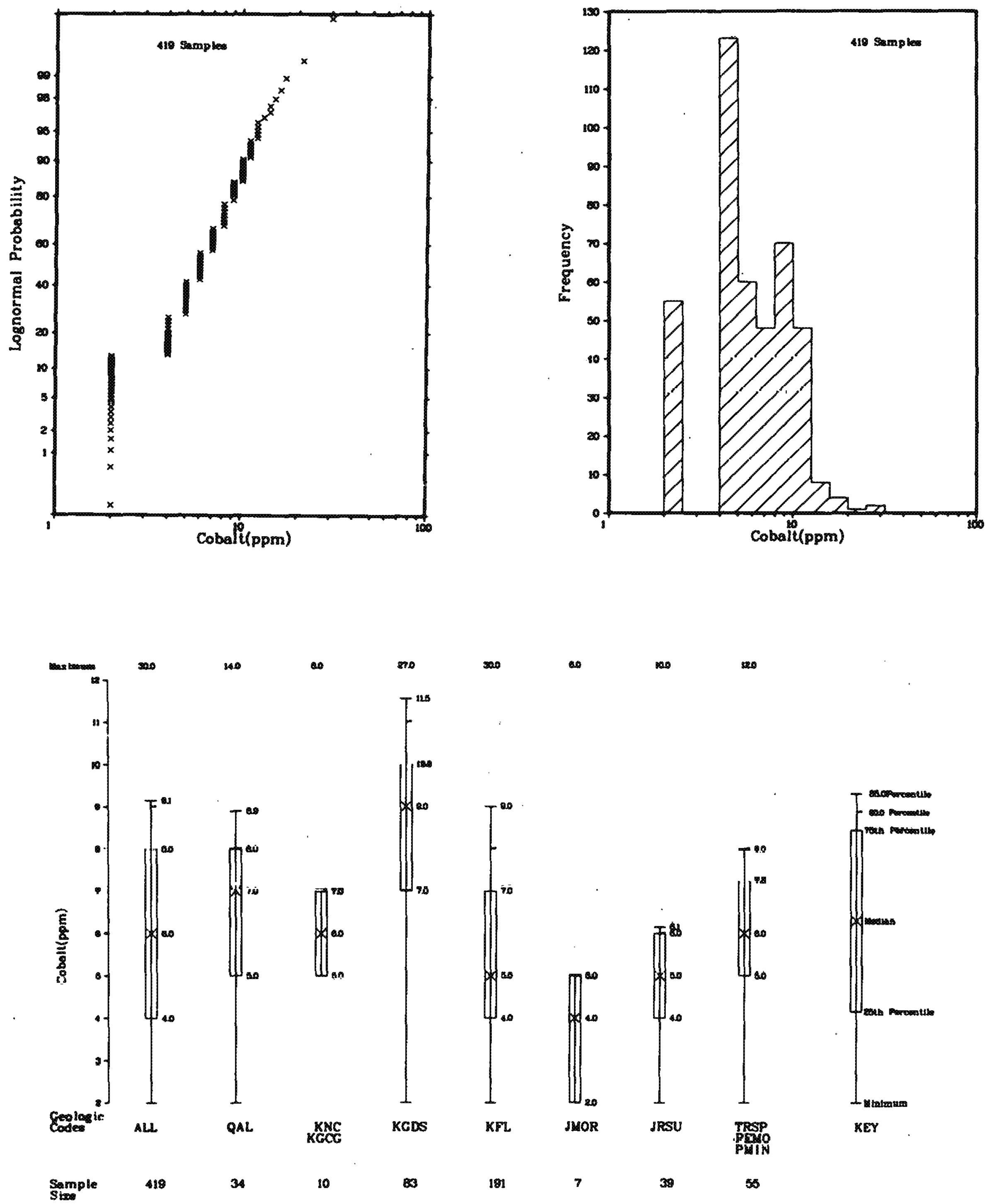
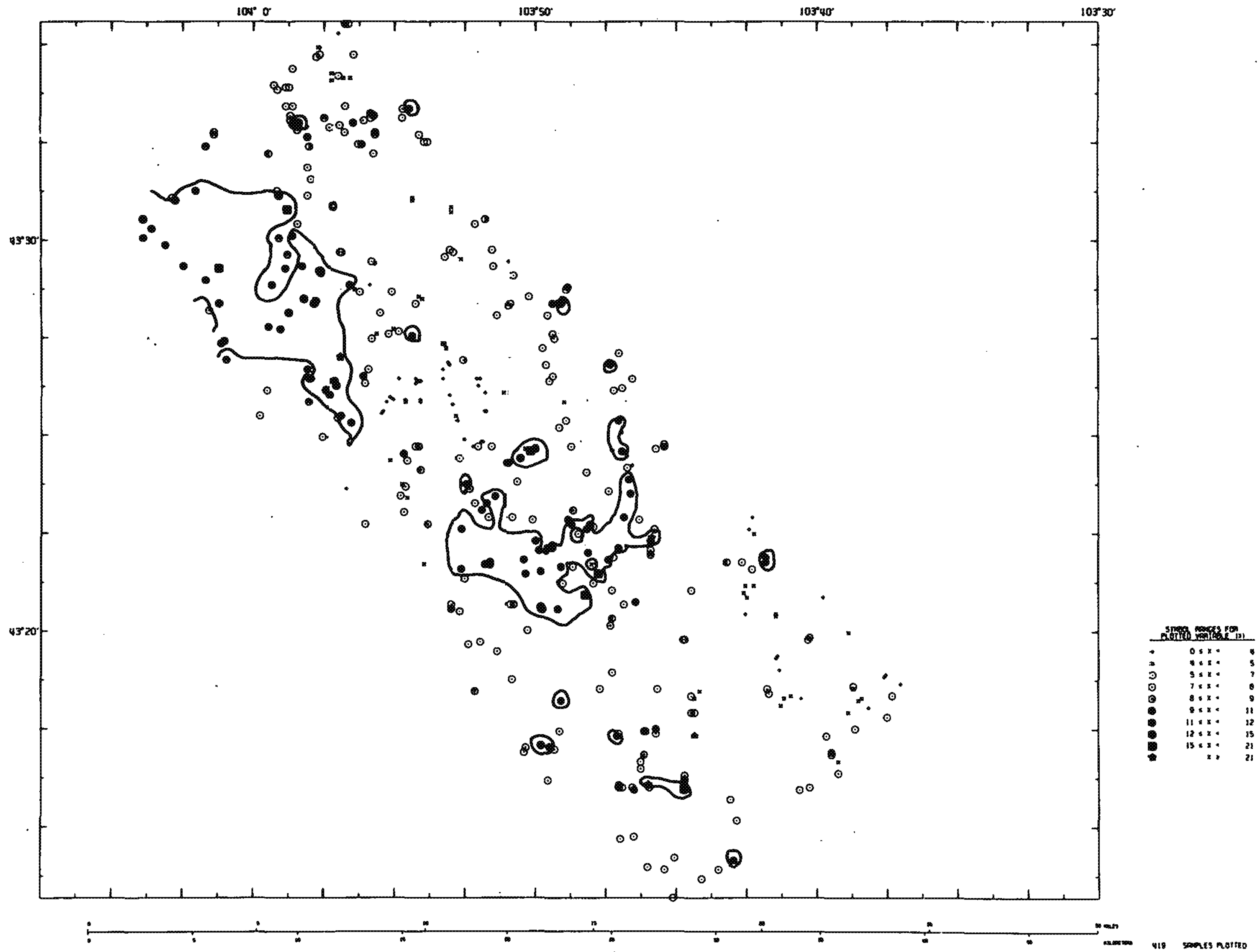


Figure B-9a

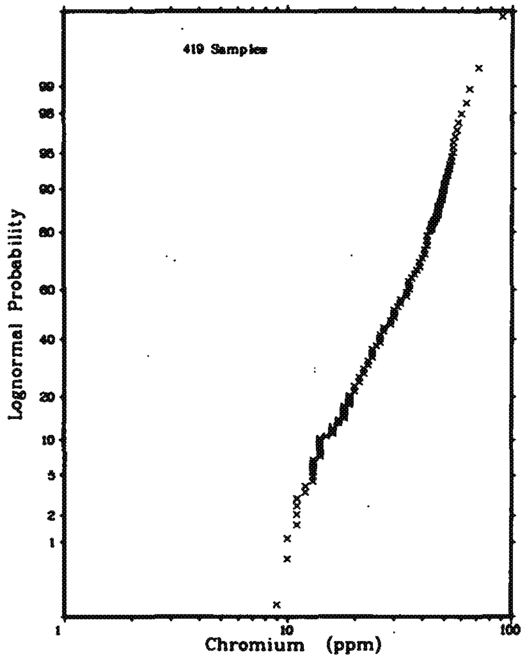
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR COBALT (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

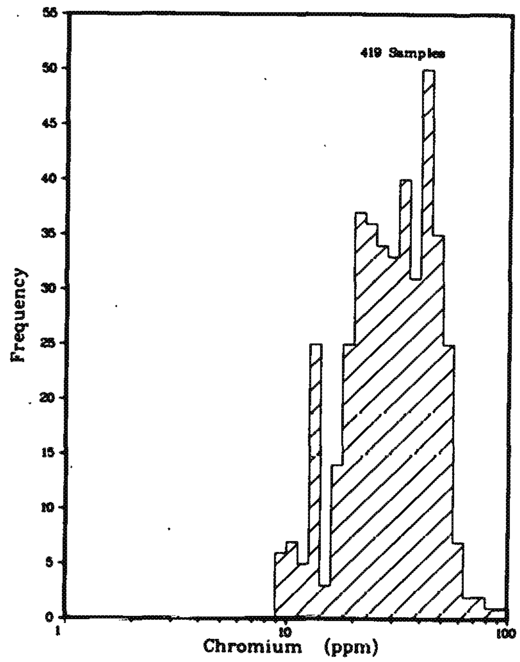


Approximate
Contour
≤9 ppm

Figure B-9b

GEOCHEMICAL DISTRIBUTION OF COBALT (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





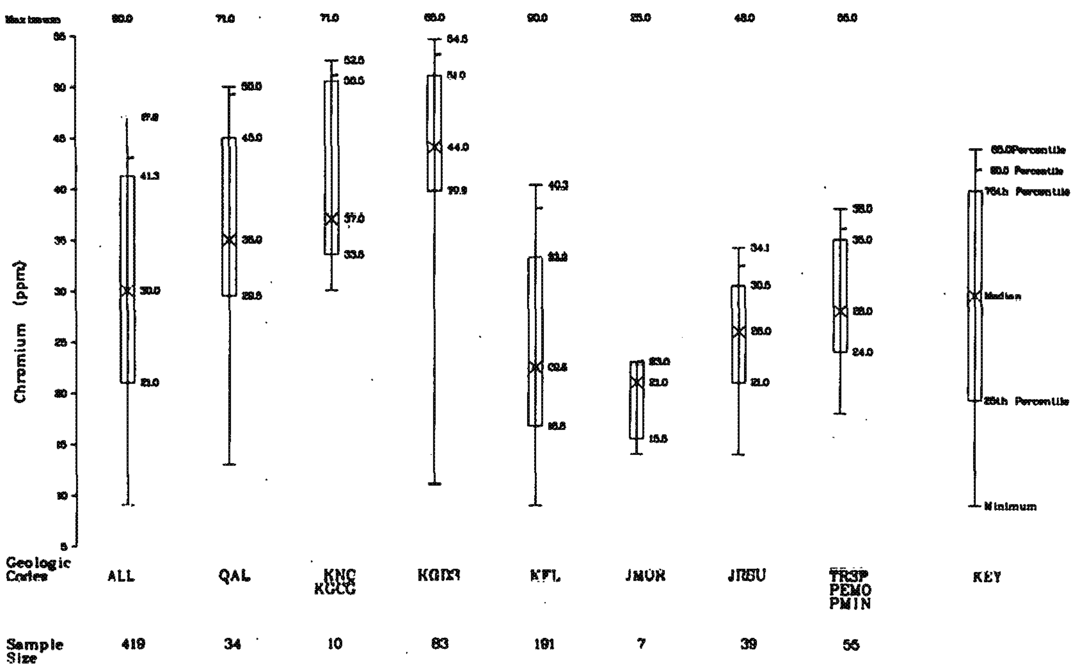
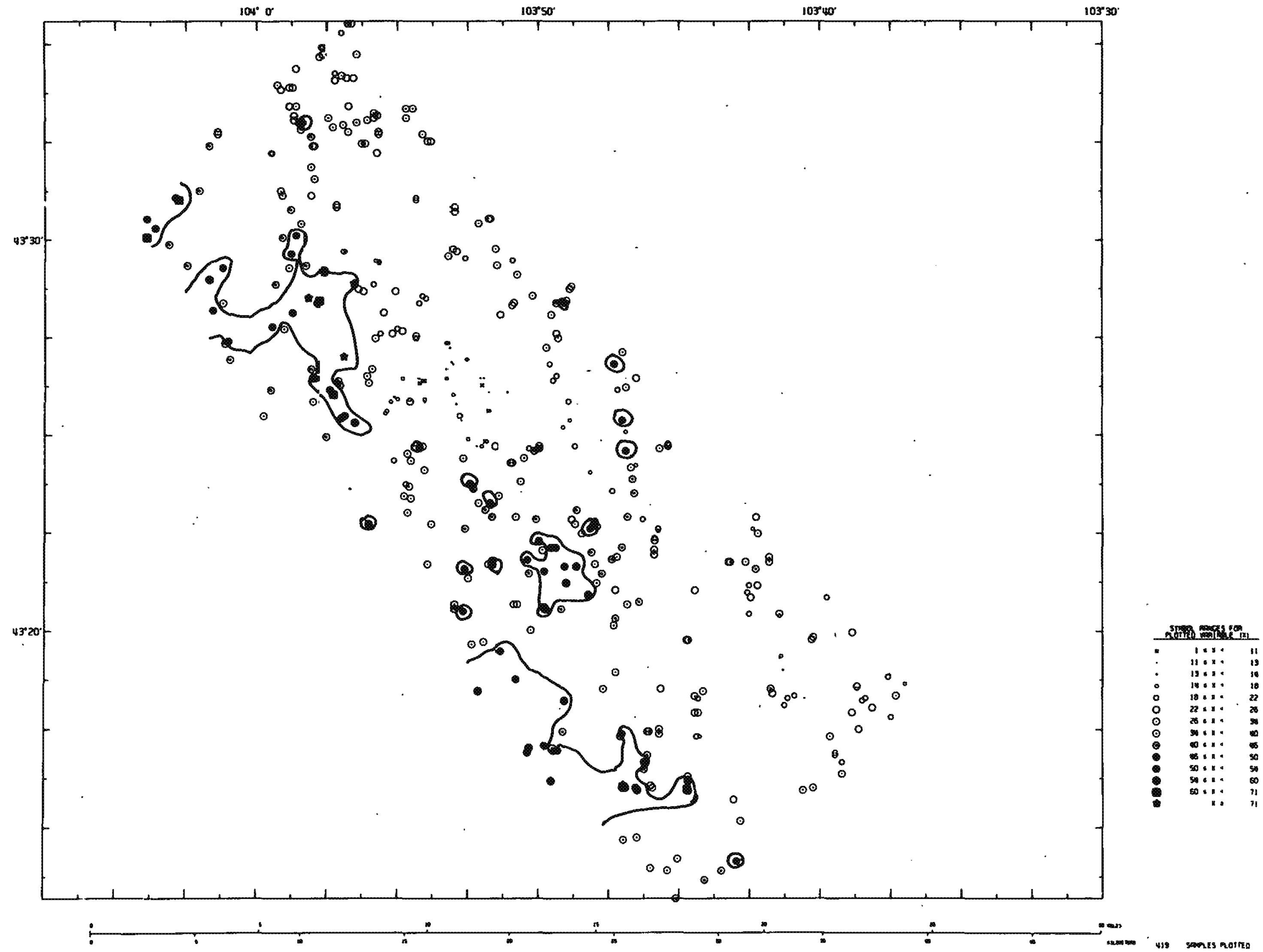


Figure B-10a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR CHROMIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤46 ppm

Figure B-10b

GEOCHEMICAL DISTRIBUTION OF CHROMIUM (PPM) IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

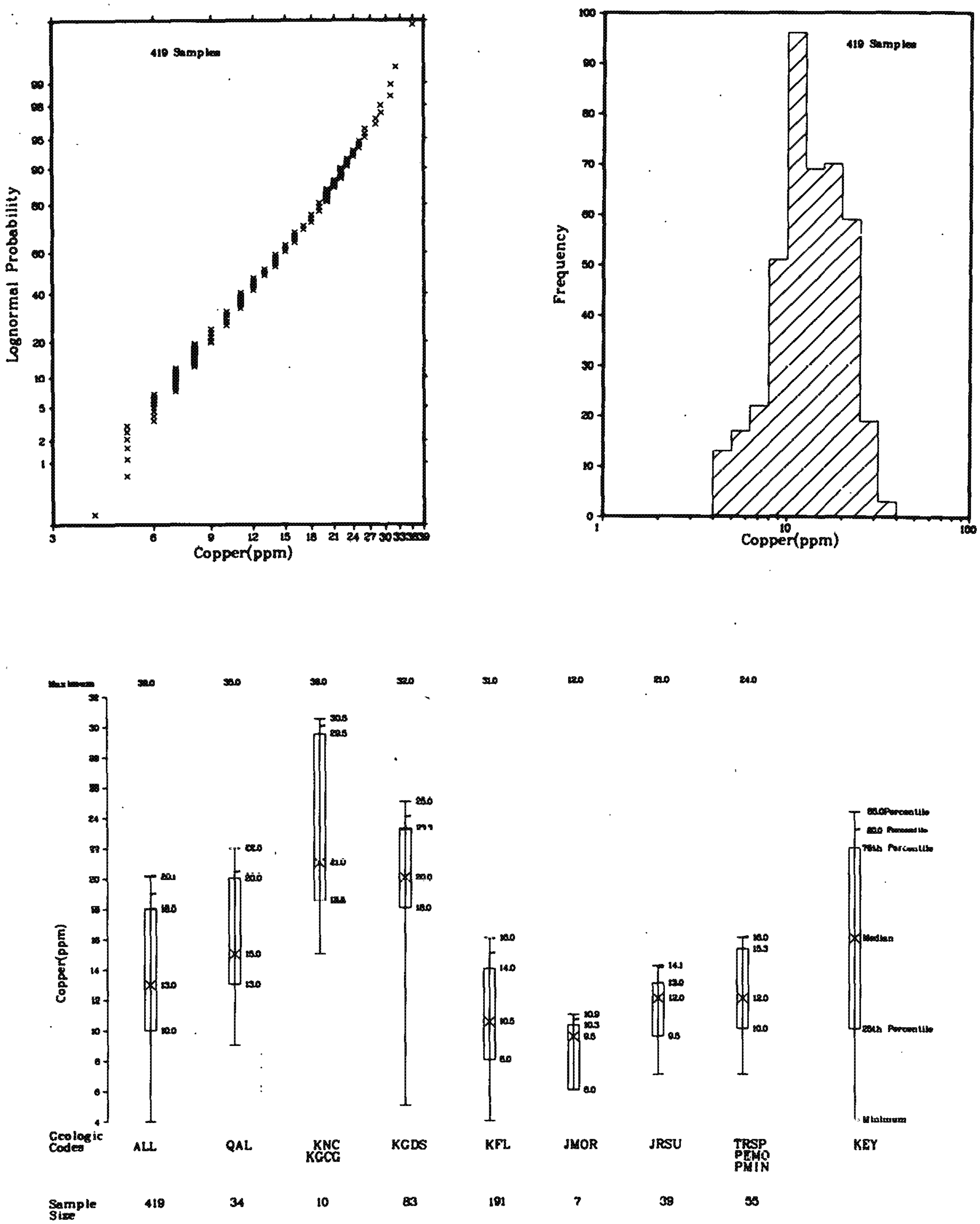
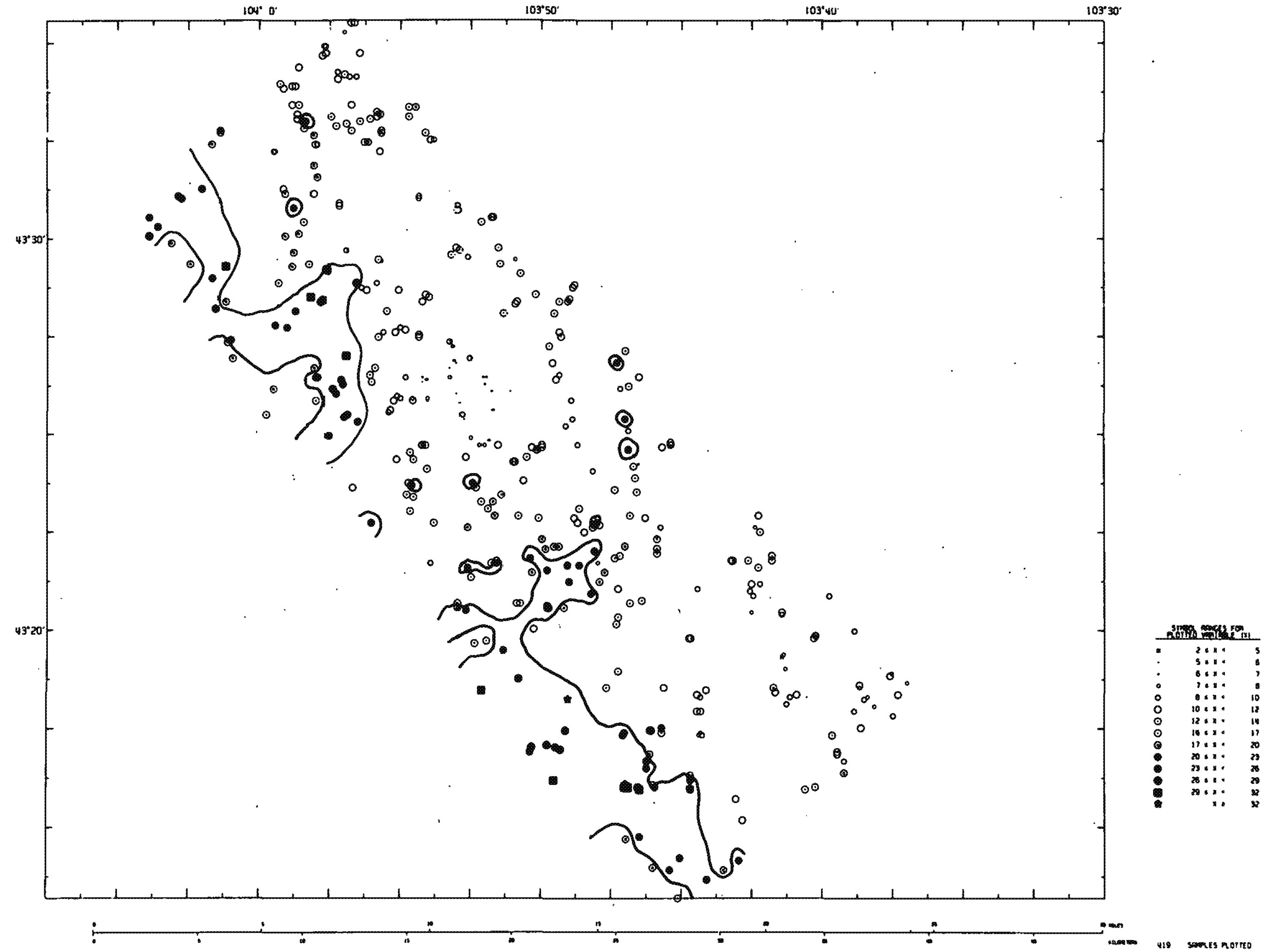


Figure B-11a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR COPPER (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate Contour ≤20 ppm

Figure B-11b

GEOCHEMICAL DISTRIBUTION OF COPPER (PPM) IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

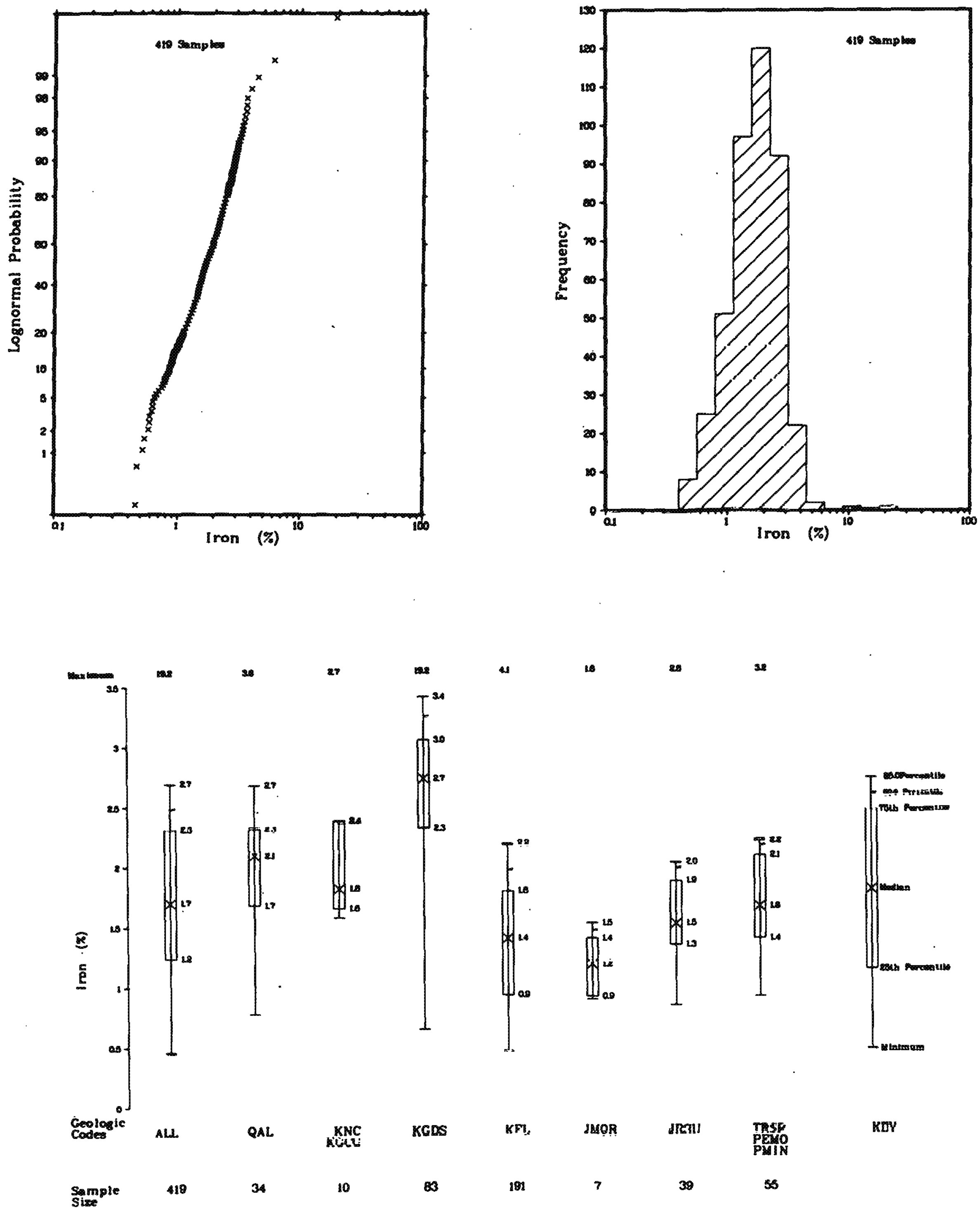
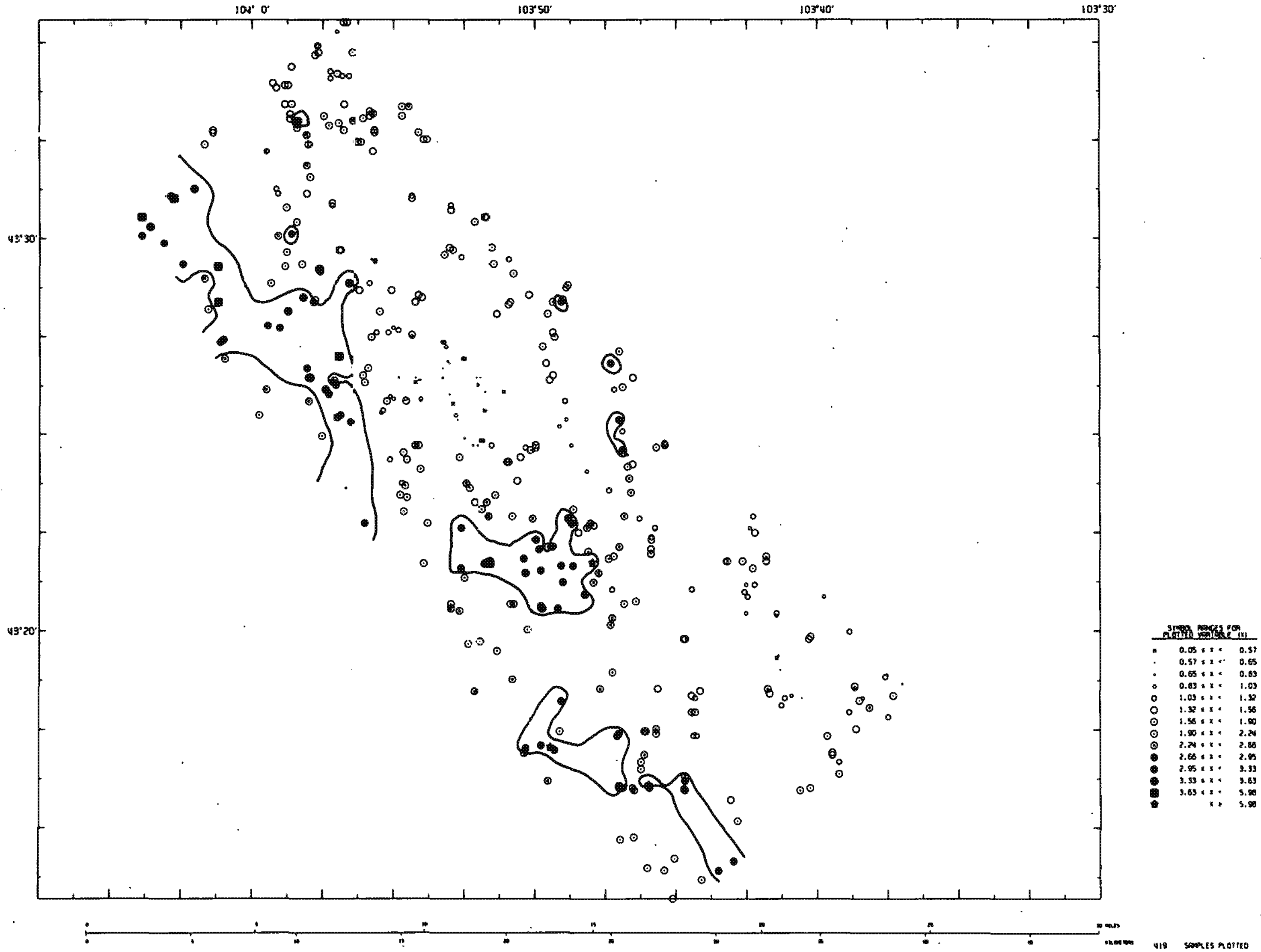


Figure B-12a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR IRON (%)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤2.66%

Figure B-12b

GEOCHEMICAL DISTRIBUTION OF IRON (%) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

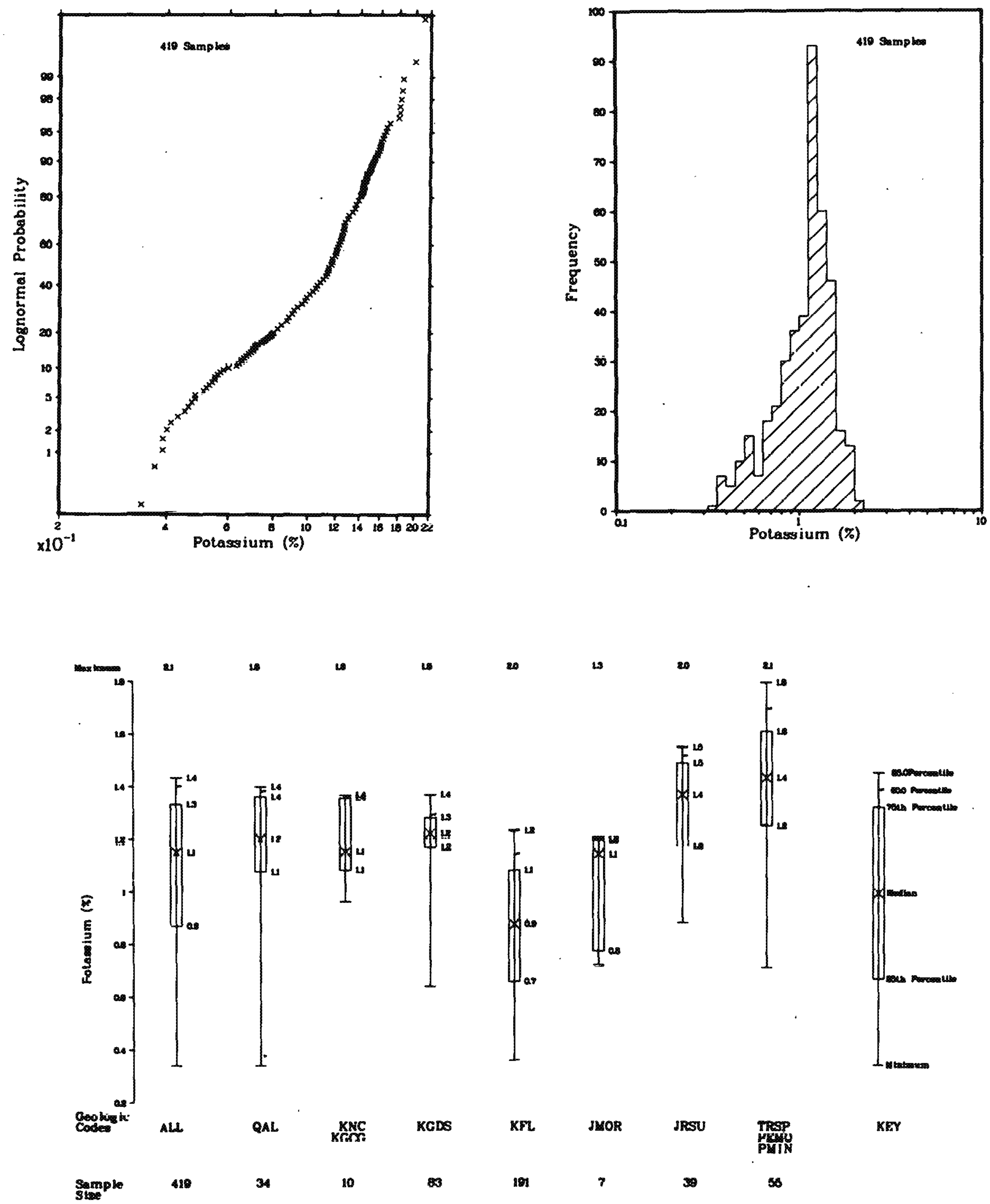
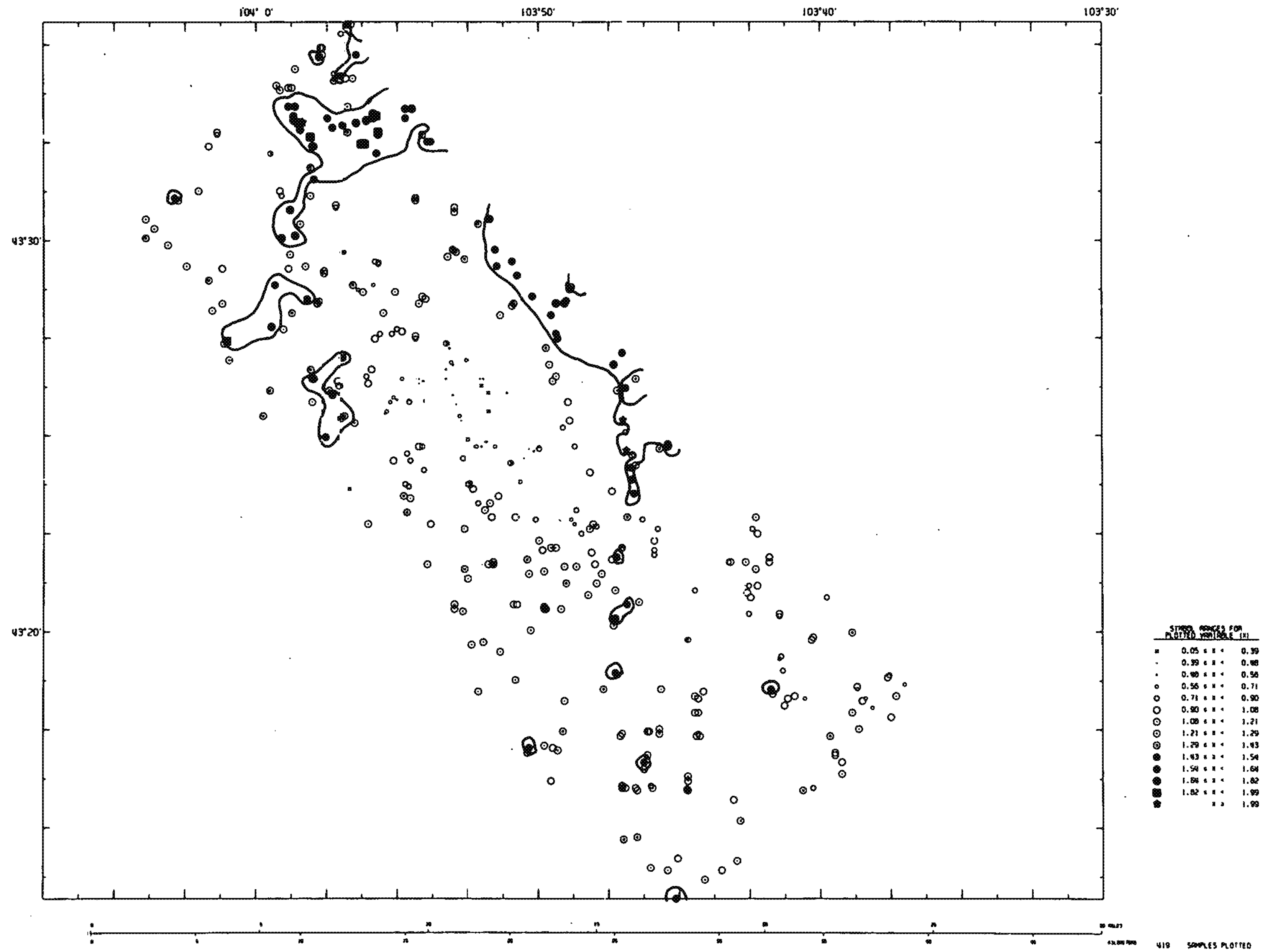


Figure B-13a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR POTASSIUM (%)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤1.43%

Figure B-13b

GEOCHEMICAL DISTRIBUTION OF POTASSIUM (%) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

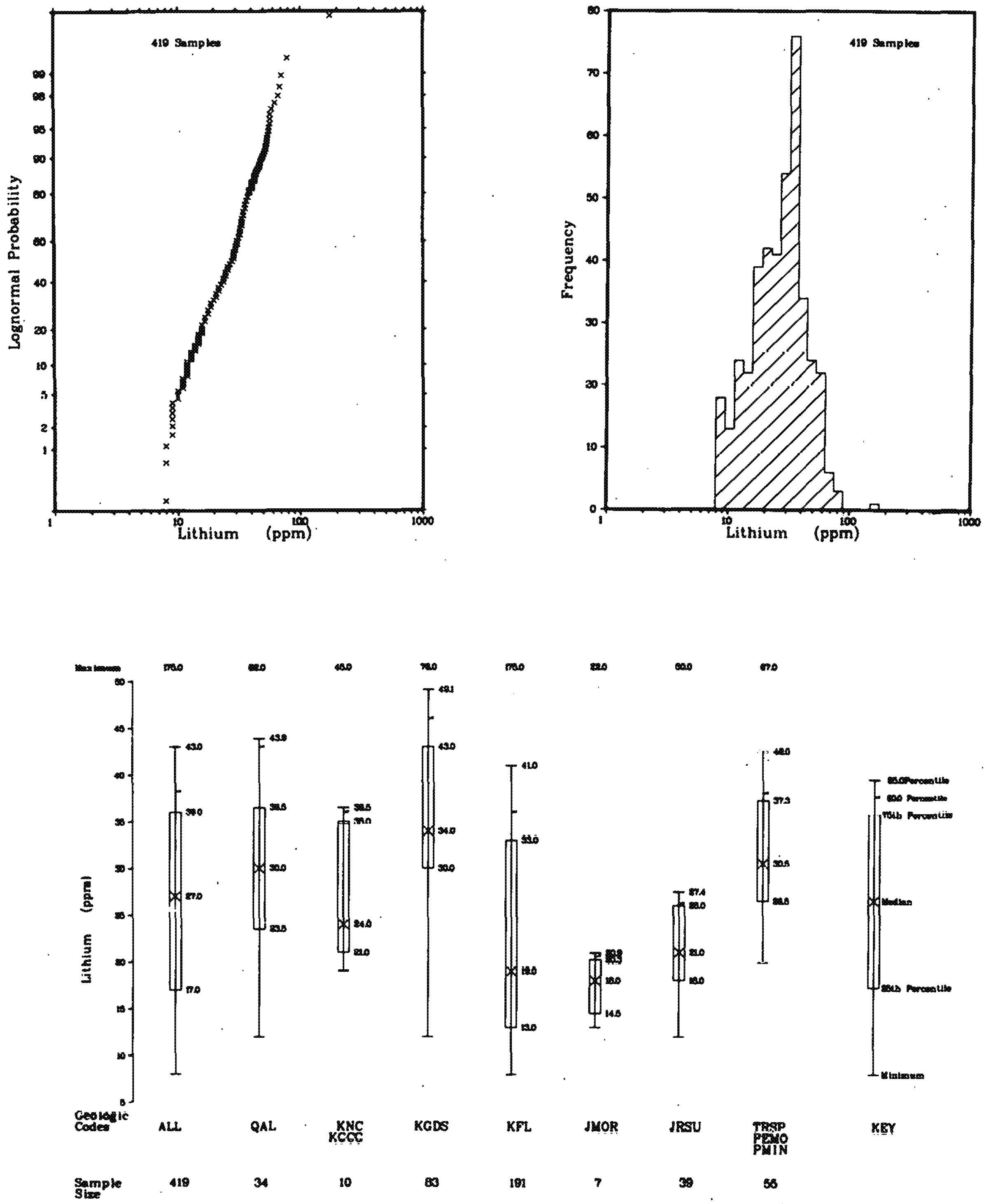
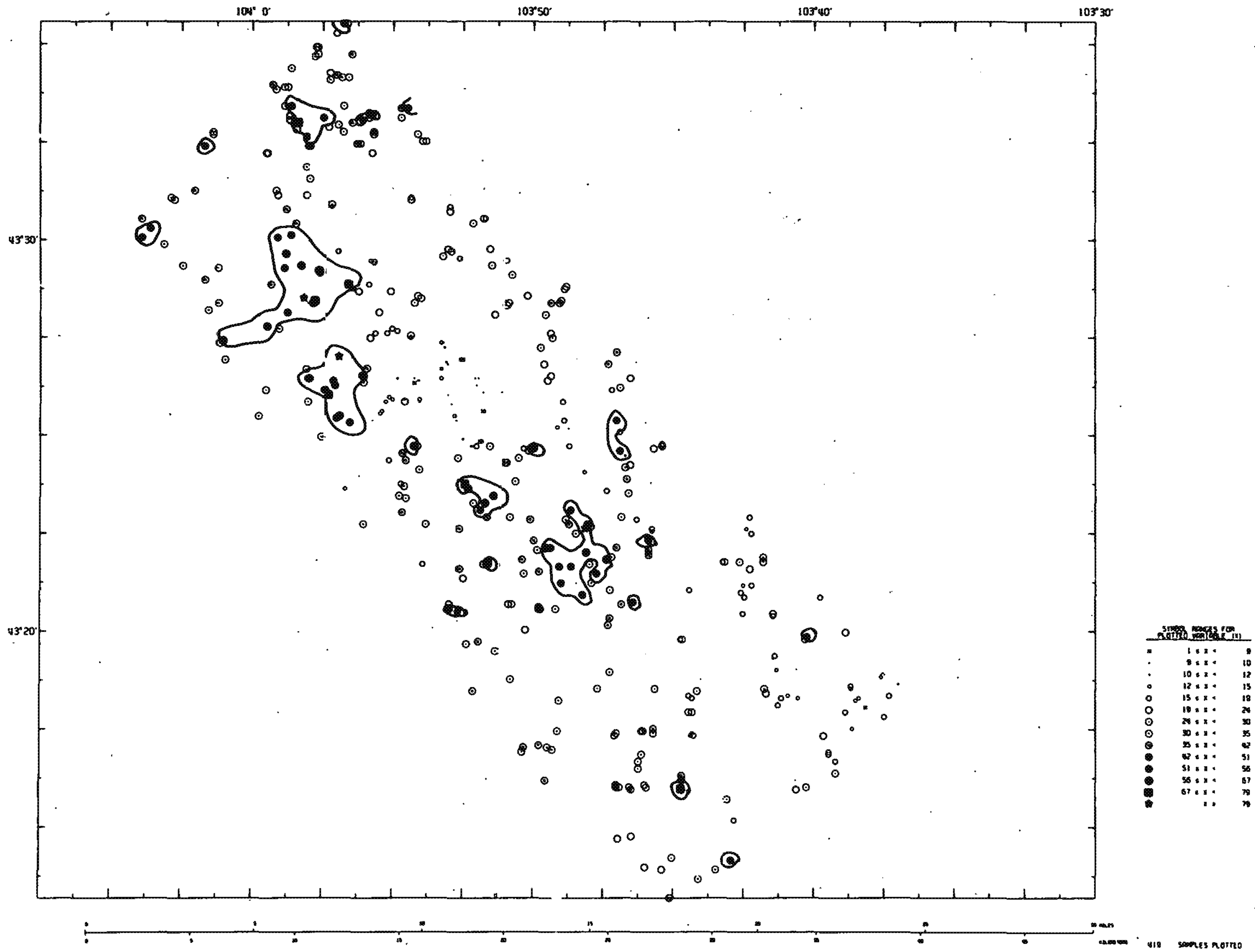


Figure B-14a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR LITHIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤42 ppm

Figure B-14b

GEOCHEMICAL DISTRIBUTION OF LITHIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

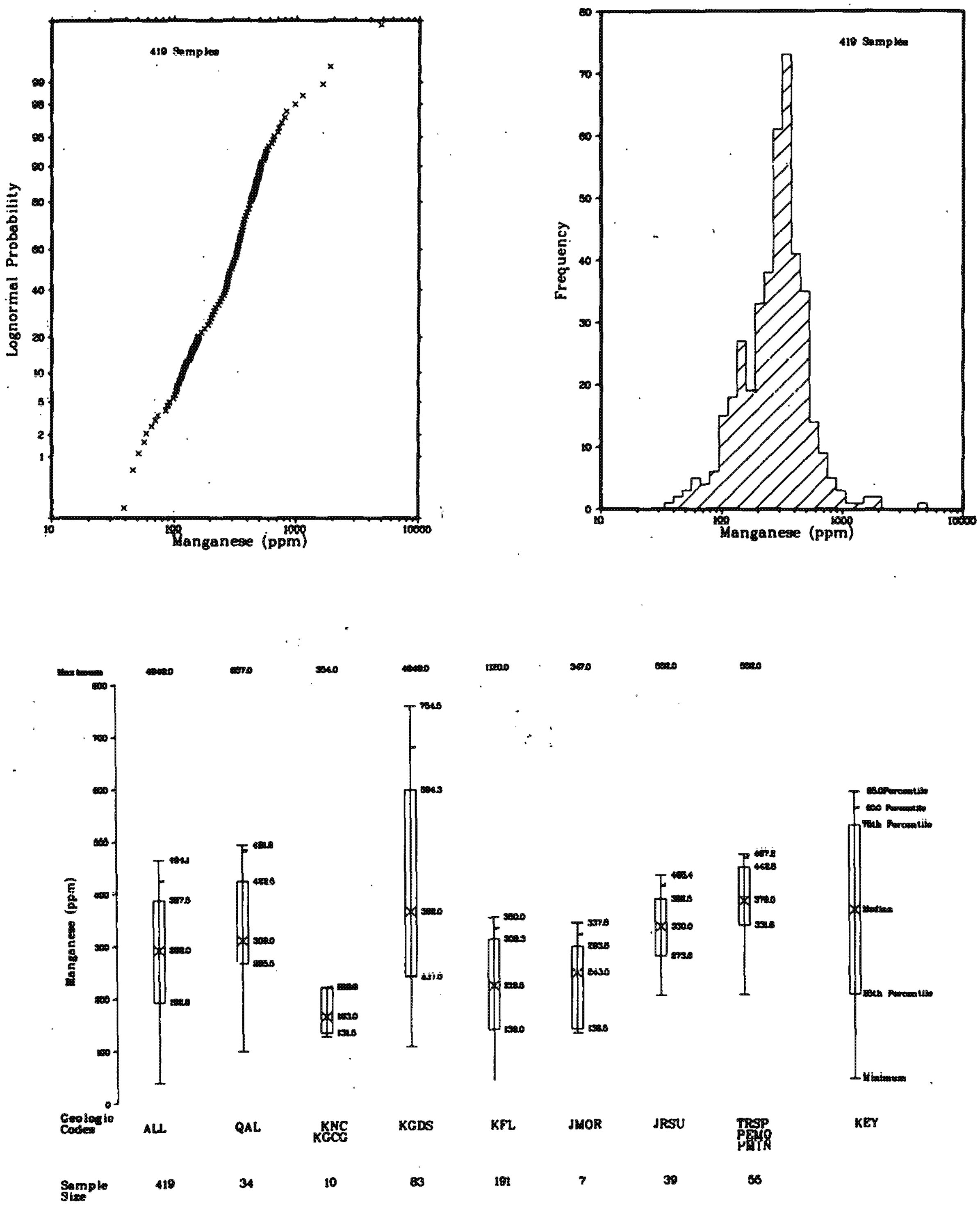
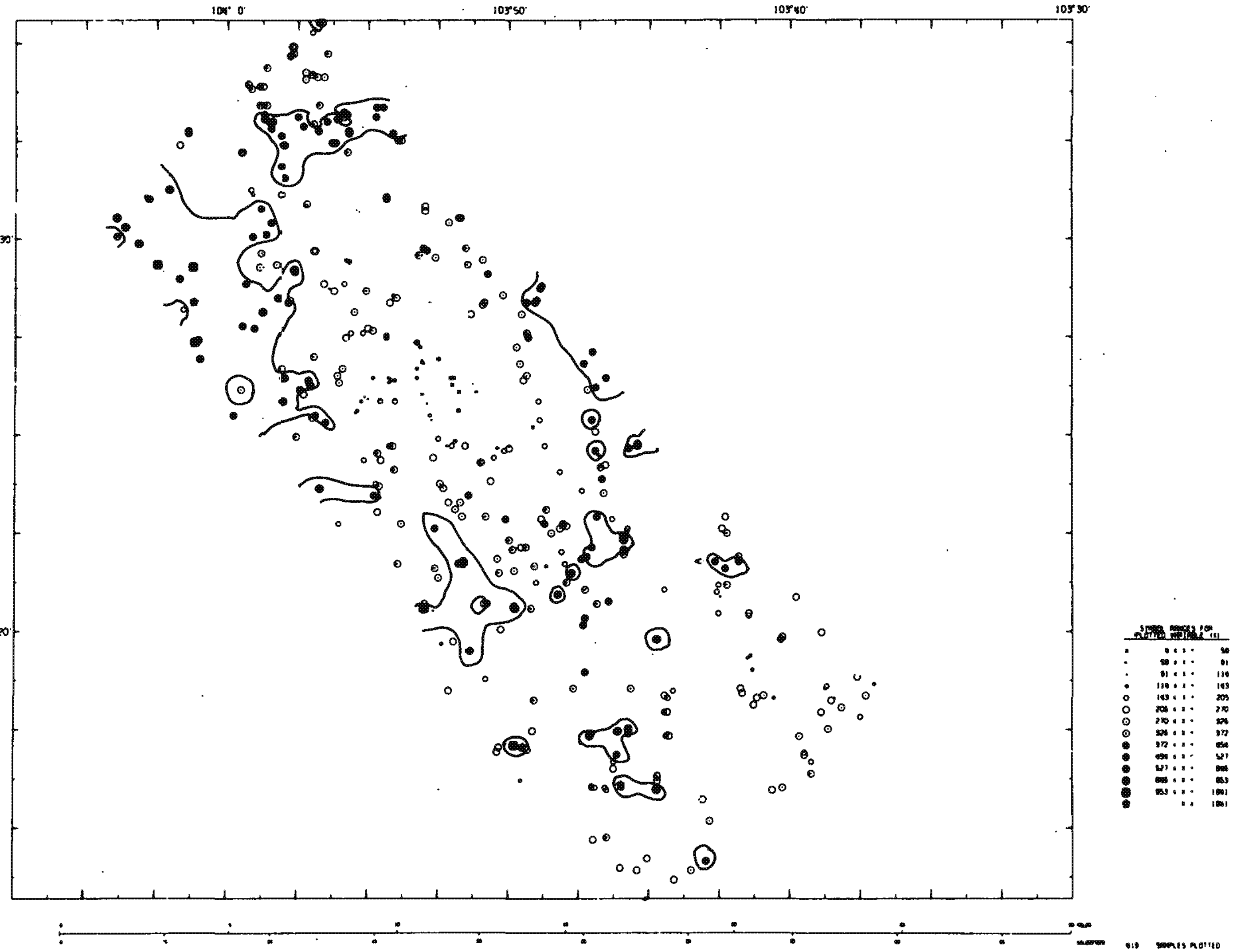


Figure B-15a

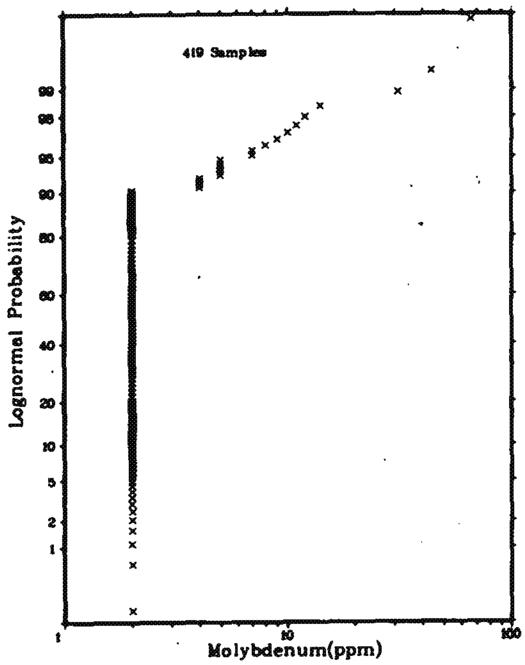
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MANGANESE (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

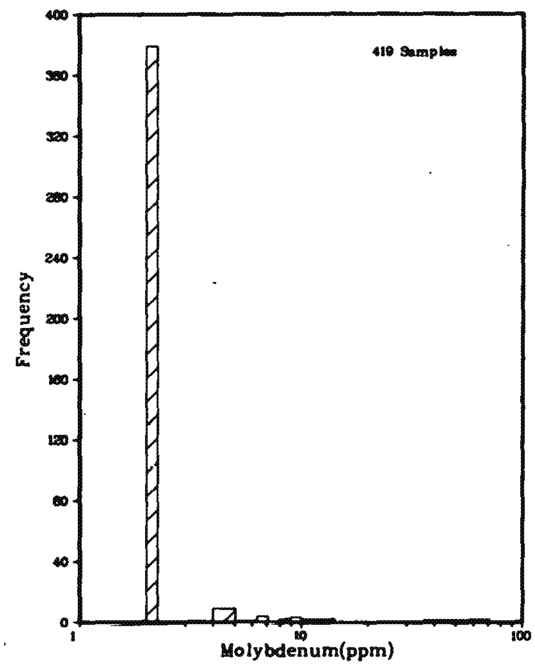


Approximate
Contour
≤454 ppm

Figure B-15b

GEOCHEMICAL DISTRIBUTION OF MANGANESE (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





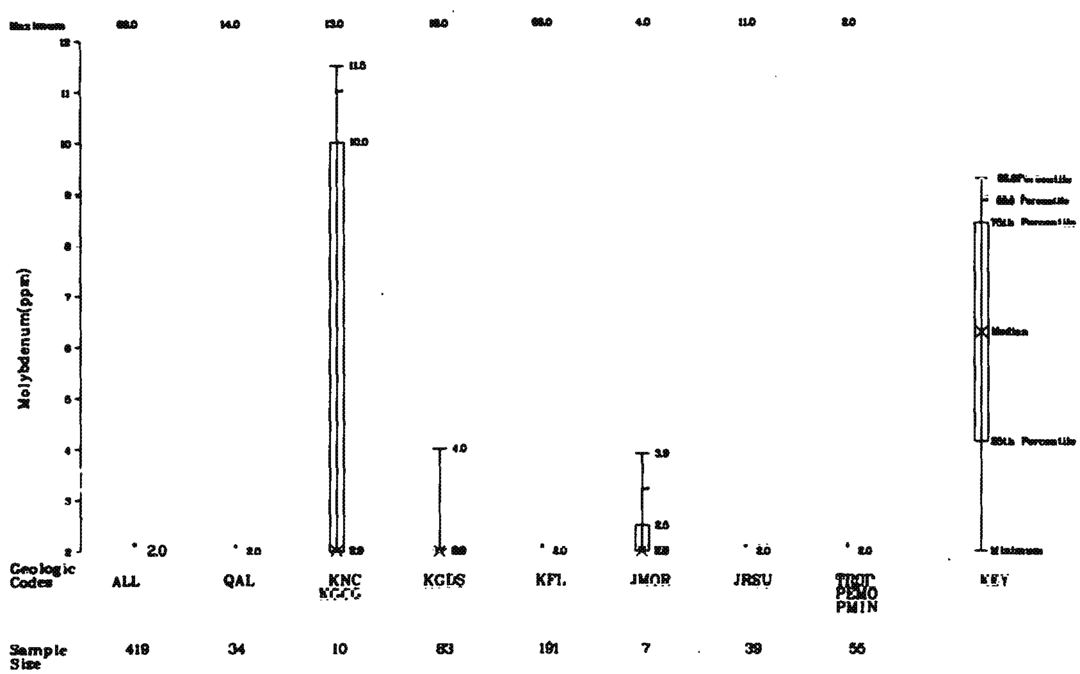
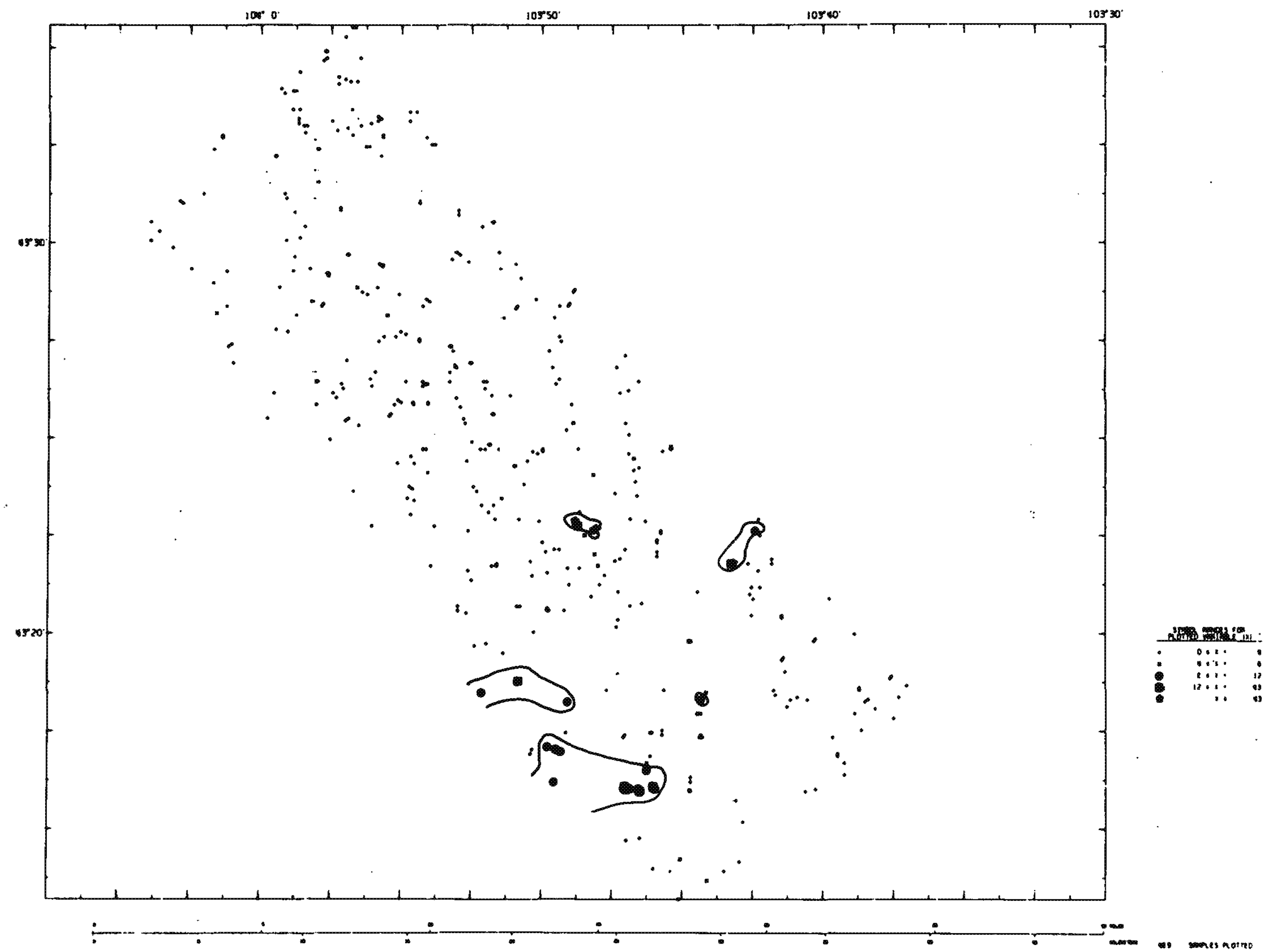


Figure B-16a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MOLYBDENUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤6 ppm

Figure B-16b

GEOCHEMICAL DISTRIBUTION OF MOLYBDENUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

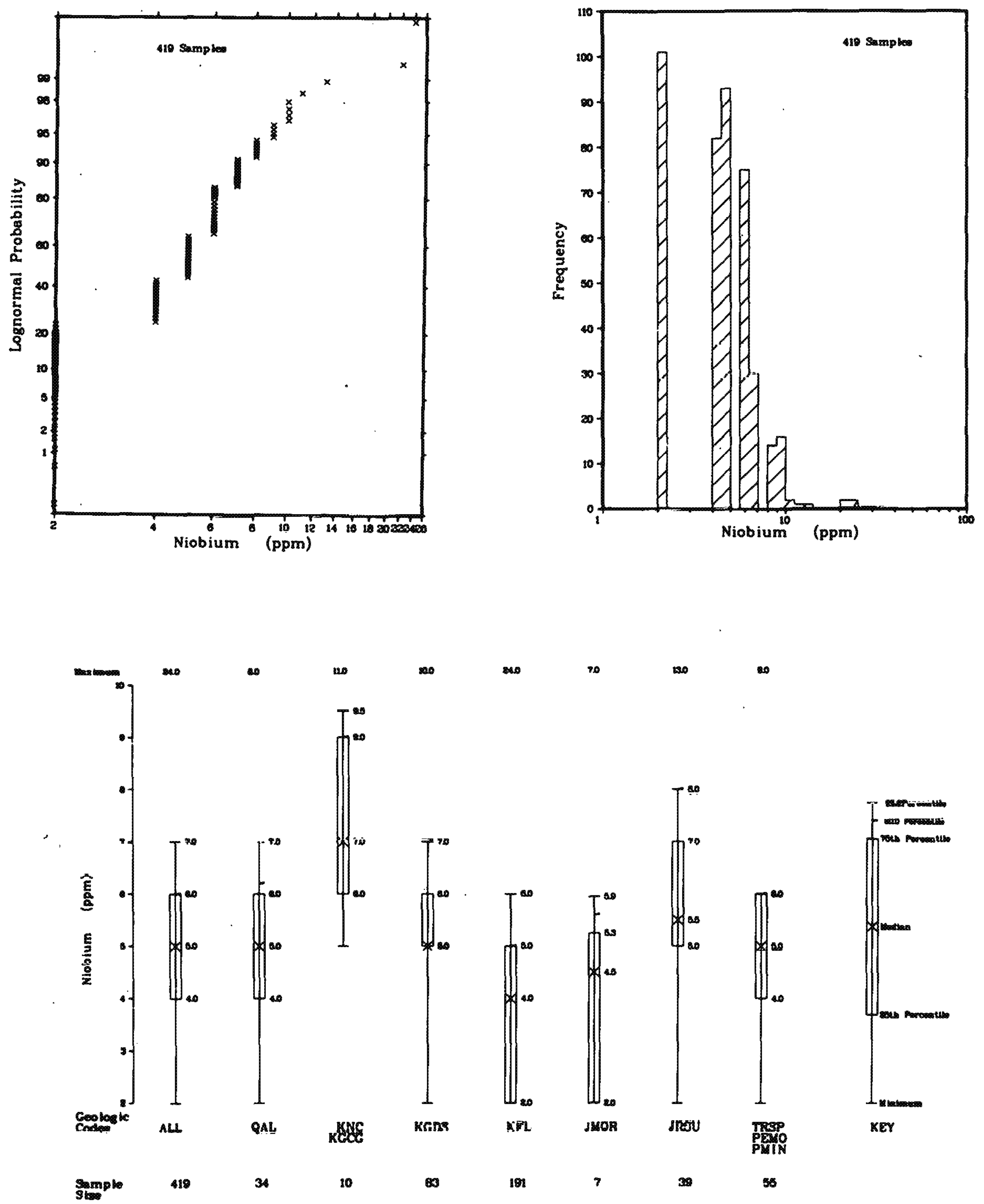
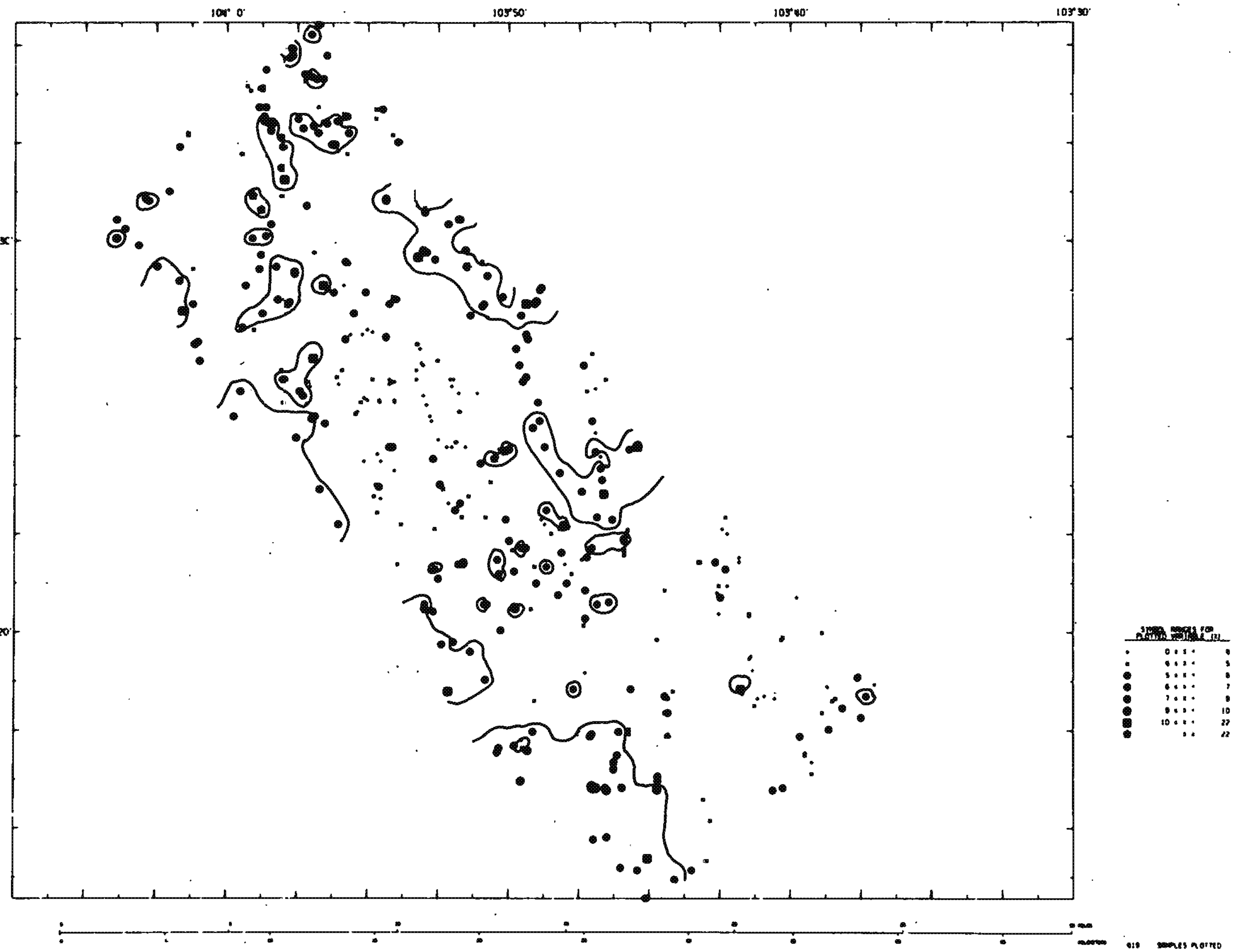


Figure B-17a

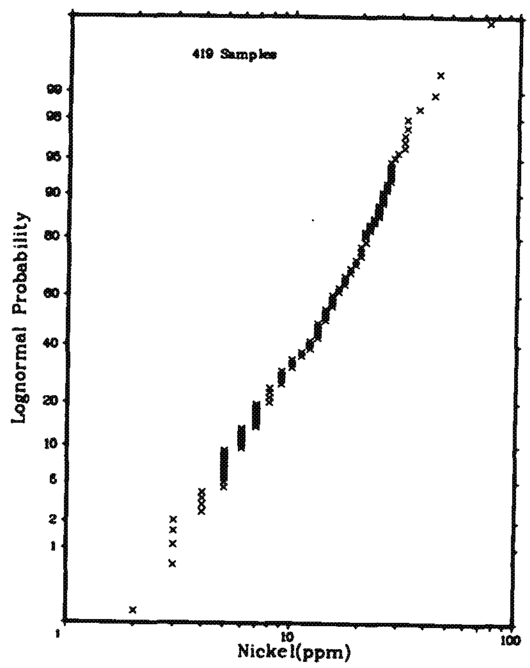
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR NIOBIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

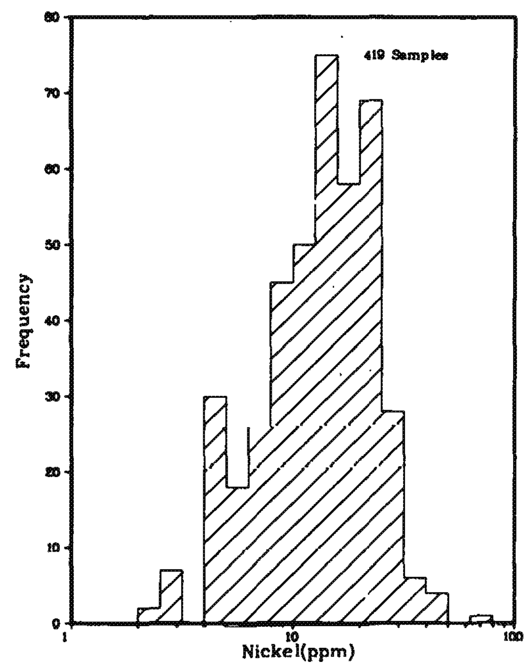


Approximate
Contour
≤6 ppm

Figure B-17b

GEOCHEMICAL DISTRIBUTION OF NIOBIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





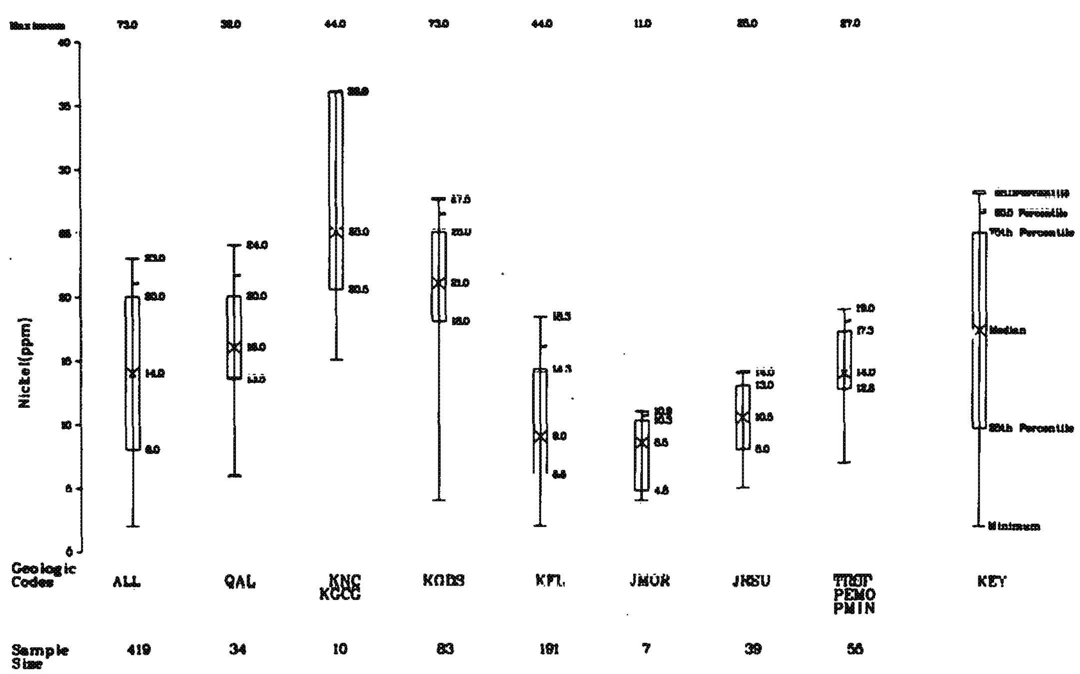
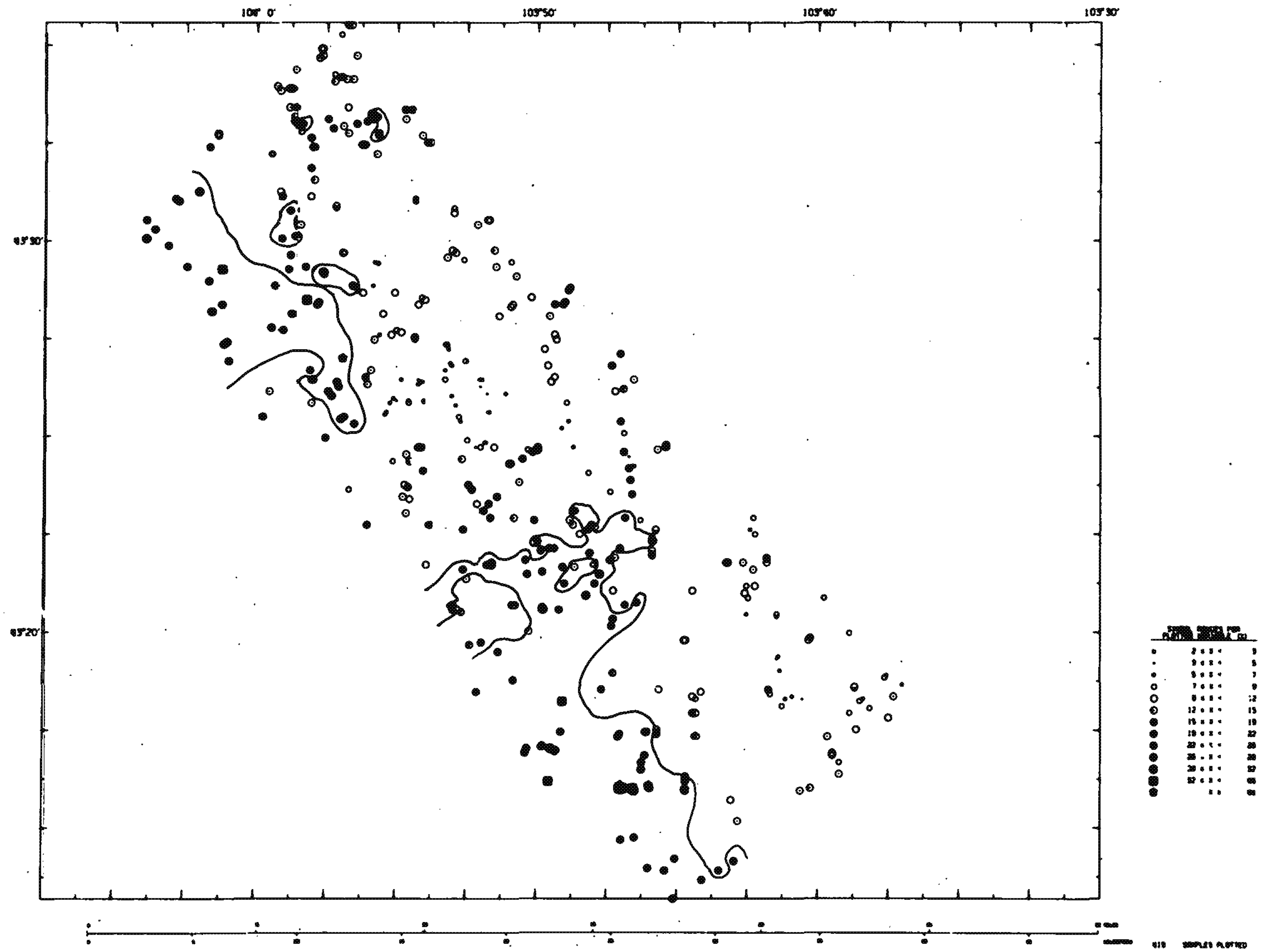


Figure B-18a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR NICKEL (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤22 ppm

Figure B-19b

GEOCHEMICAL DISTRIBUTION OF NICKEL (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

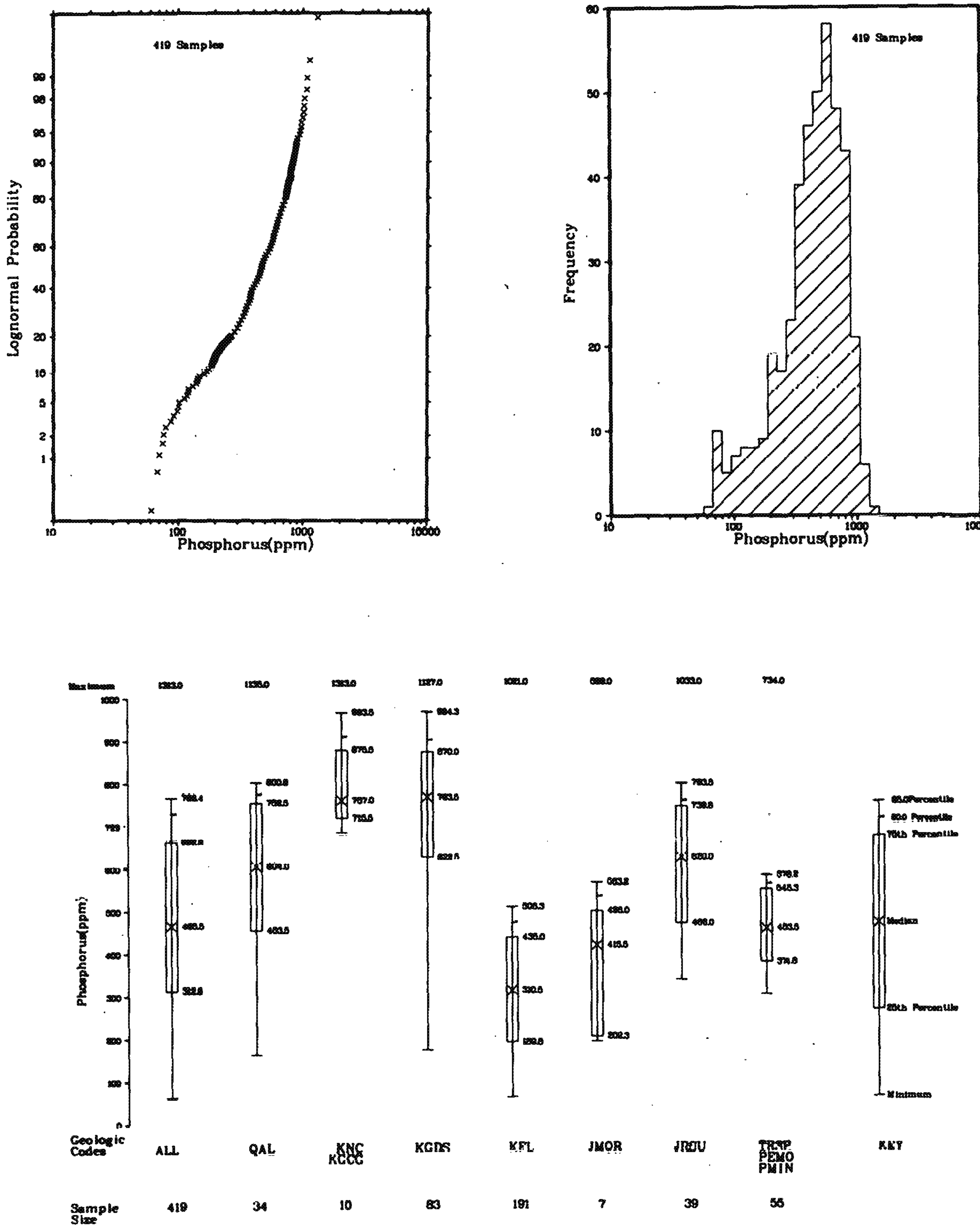
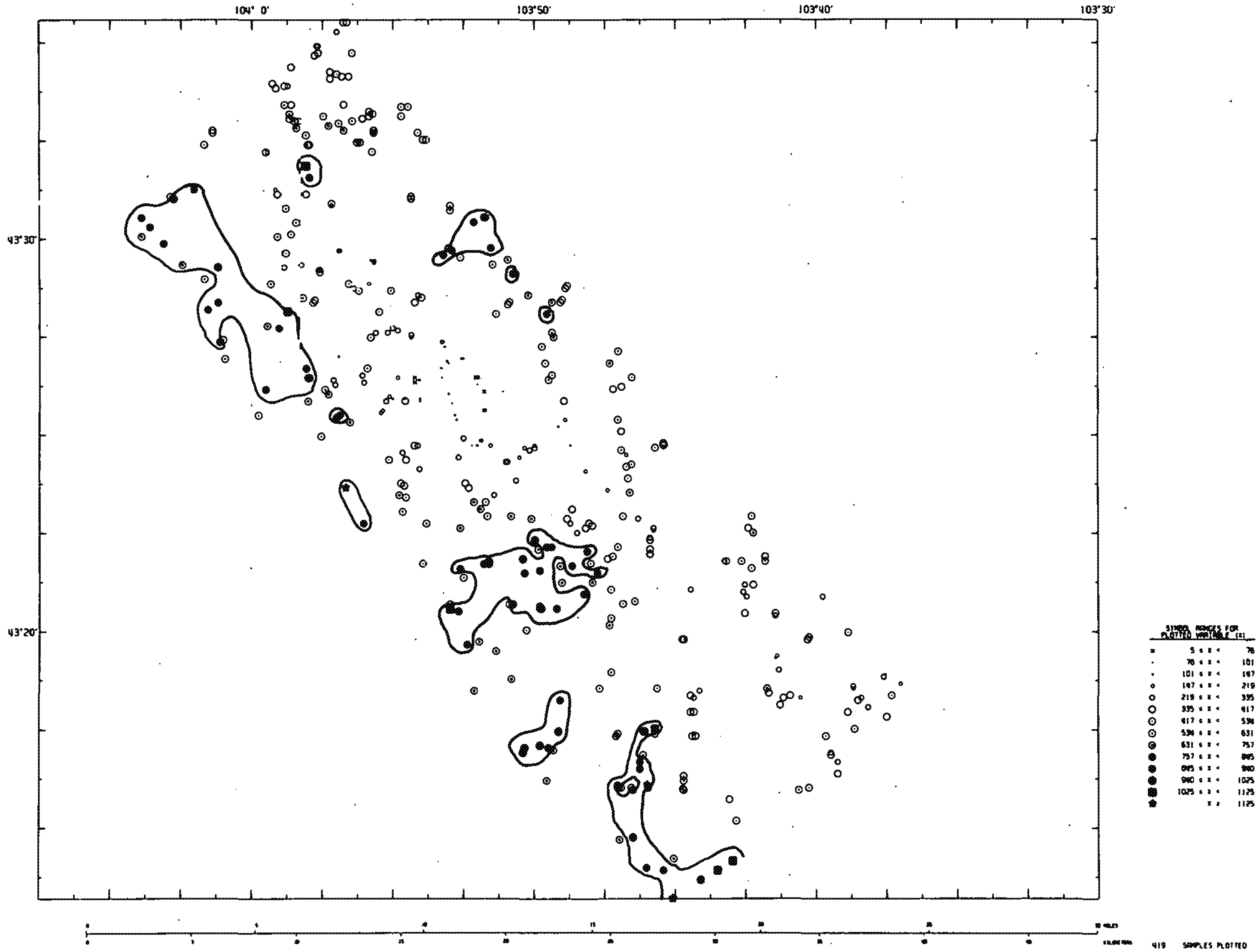


Figure B-19a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR PHOSPHORUS (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤757 ppm

Figure B-19b

GEOCHEMICAL DISTRIBUTION OF PHOSPHORUS (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

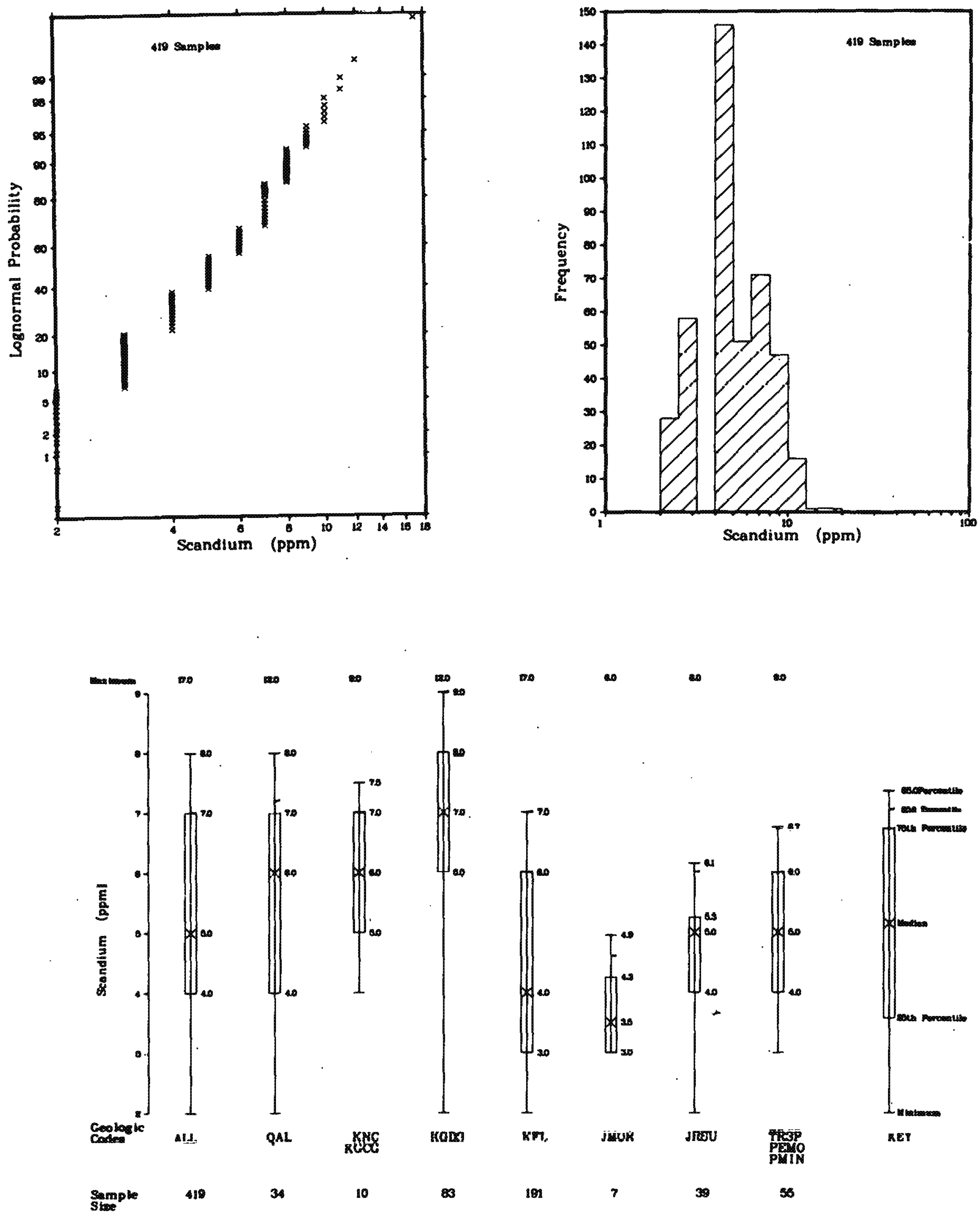
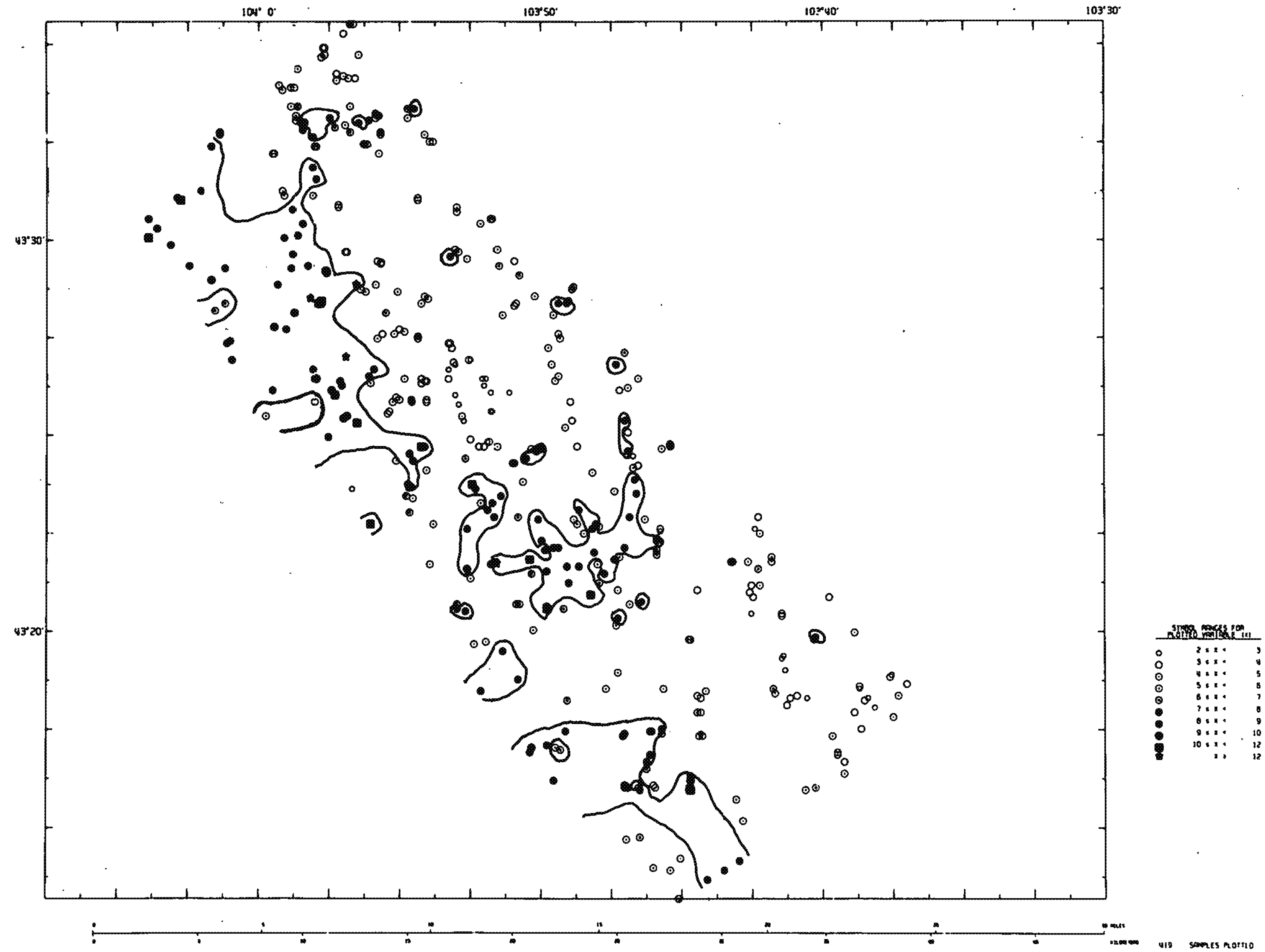


Figure B-20a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SCANDIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate Contour ≤7 ppm

Figure B-20b

GEOCHEMICAL DISTRIBUTION OF SCANDIUM (PPM) IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

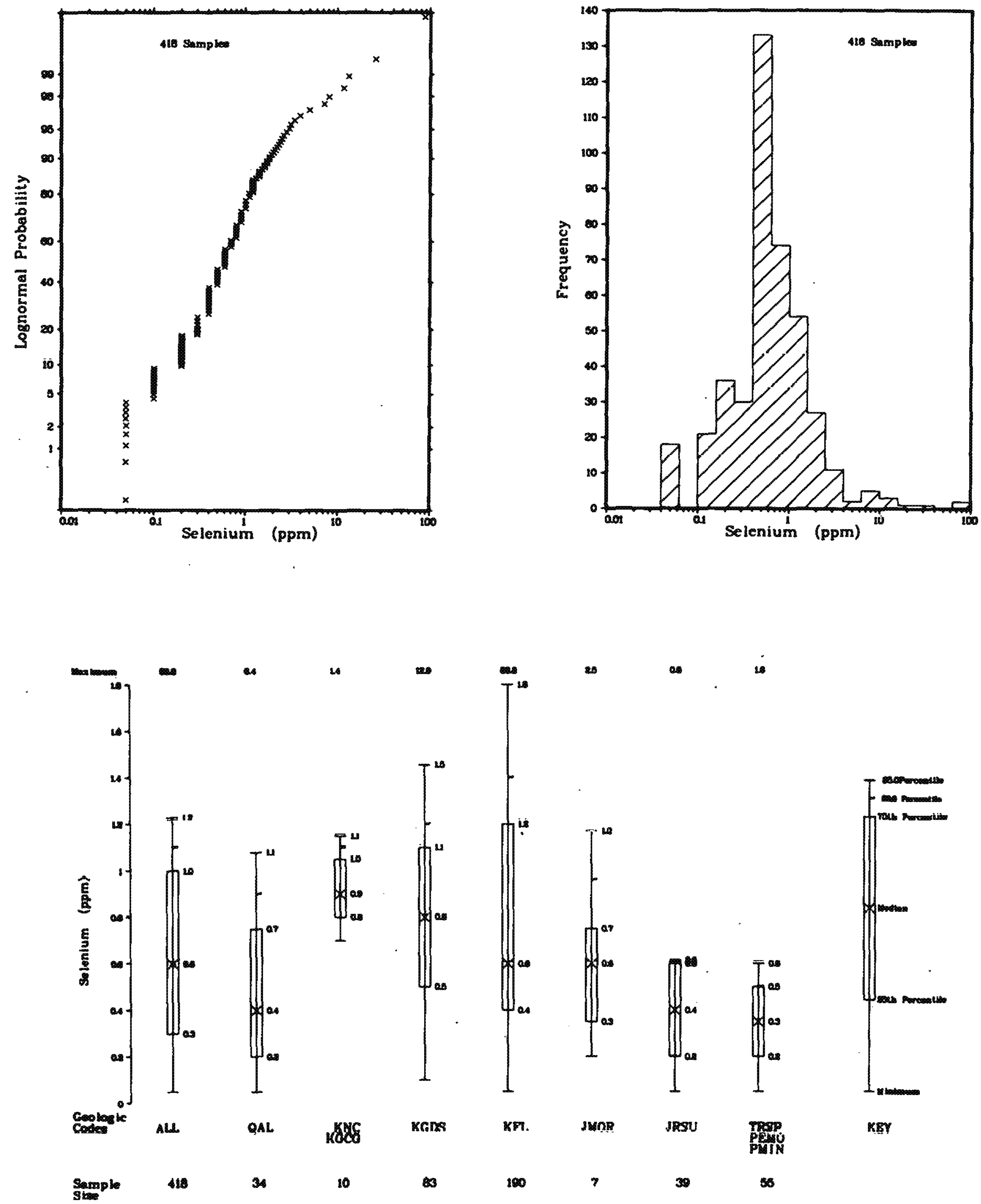
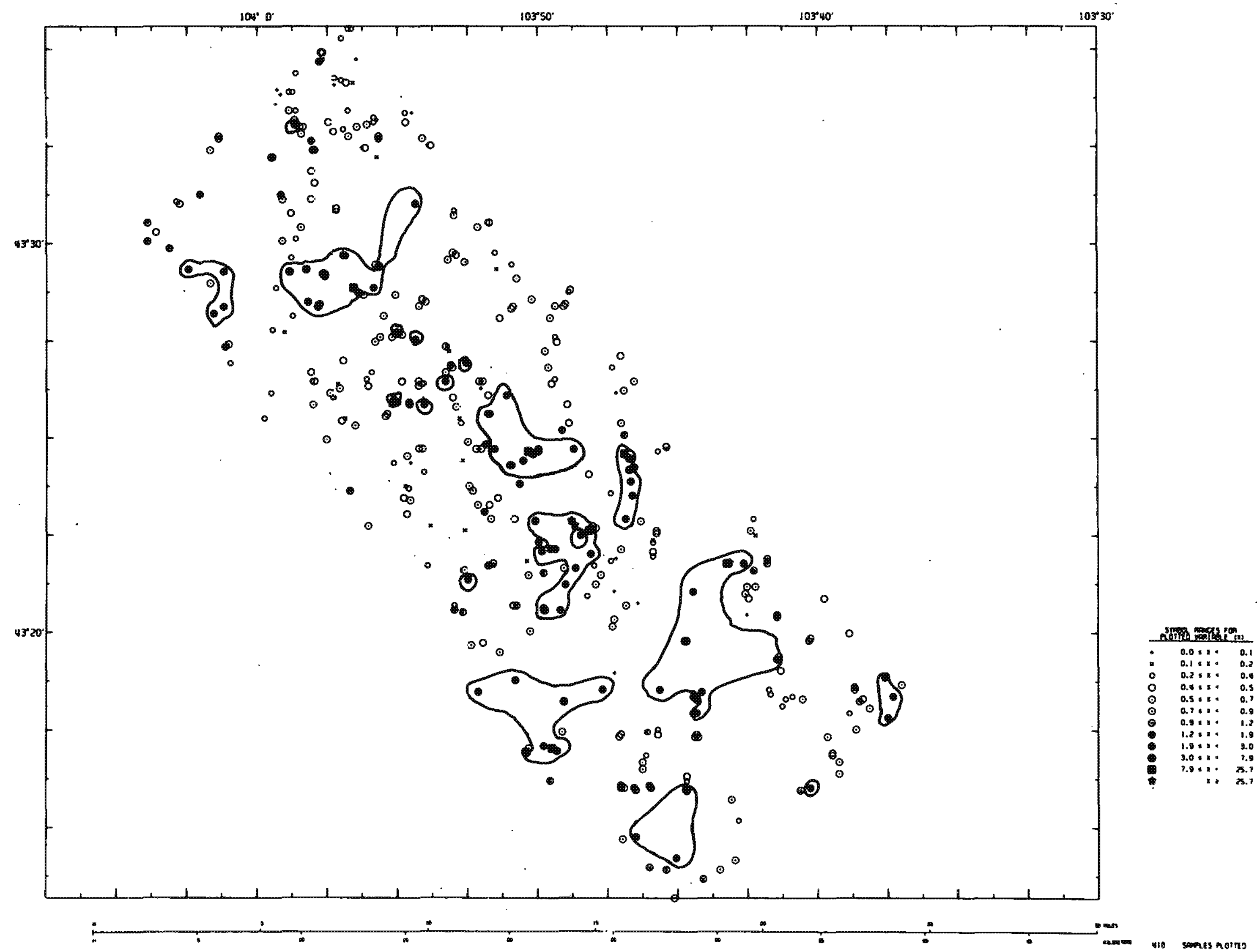


Figure B-21a

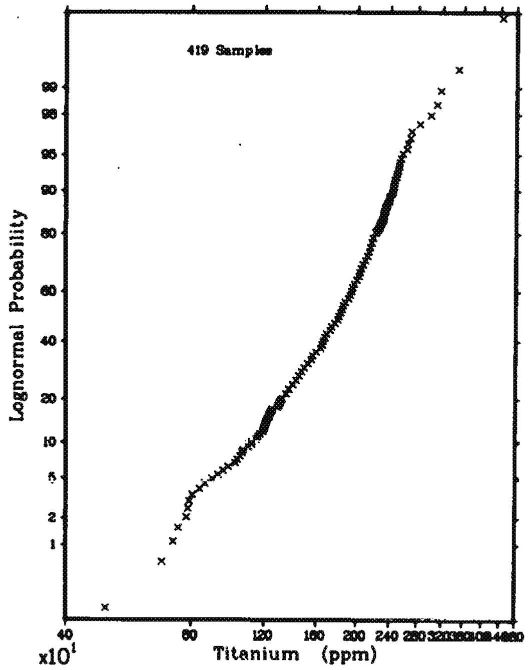
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SELENIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

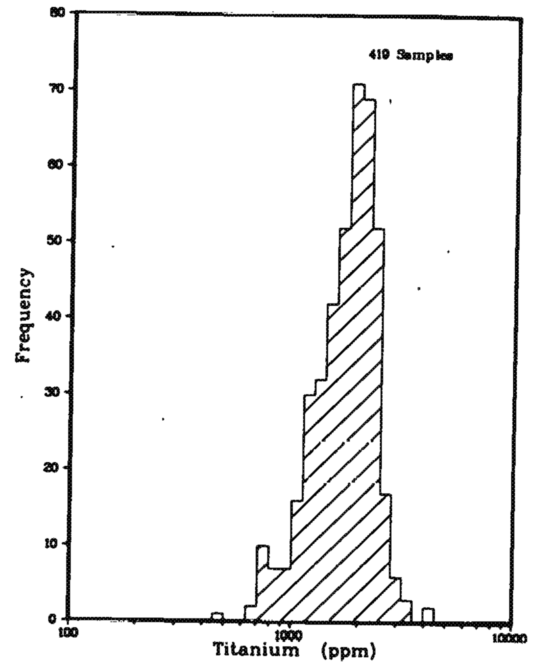


Approximate
Contour
≤1.2 ppm

Figure B-21b

GEOCHEMICAL DISTRIBUTION OF SELENIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





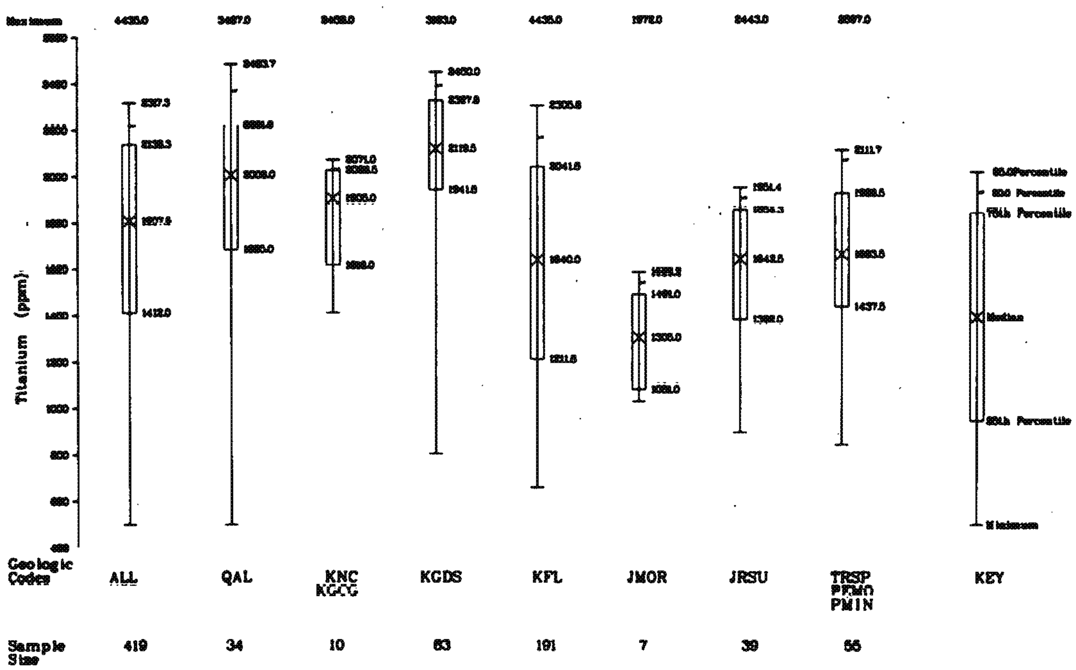
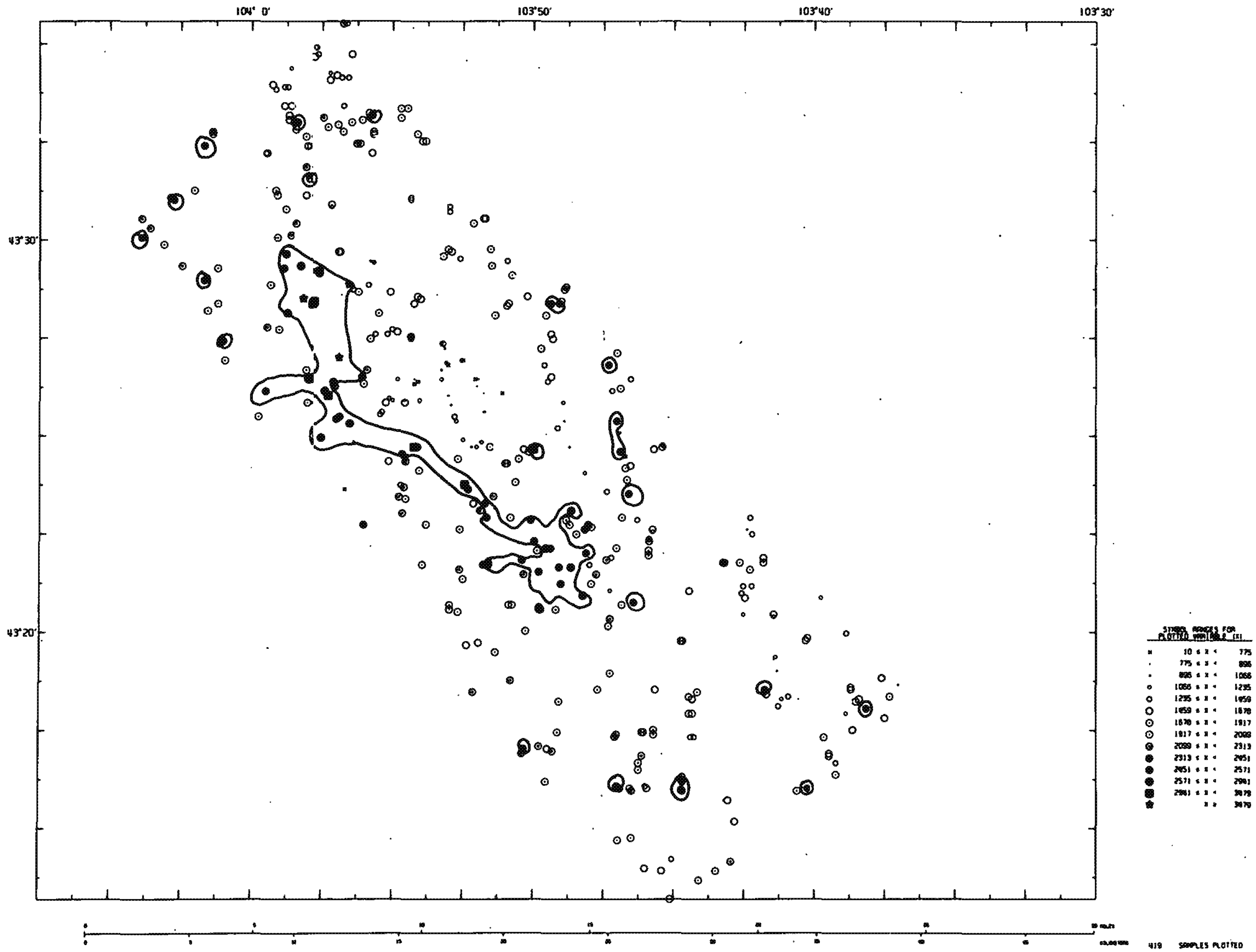


Figure B-22a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR TITANIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤2,313 ppm

Figure B-22b

GEOCHEMICAL DISTRIBUTION OF TITANIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

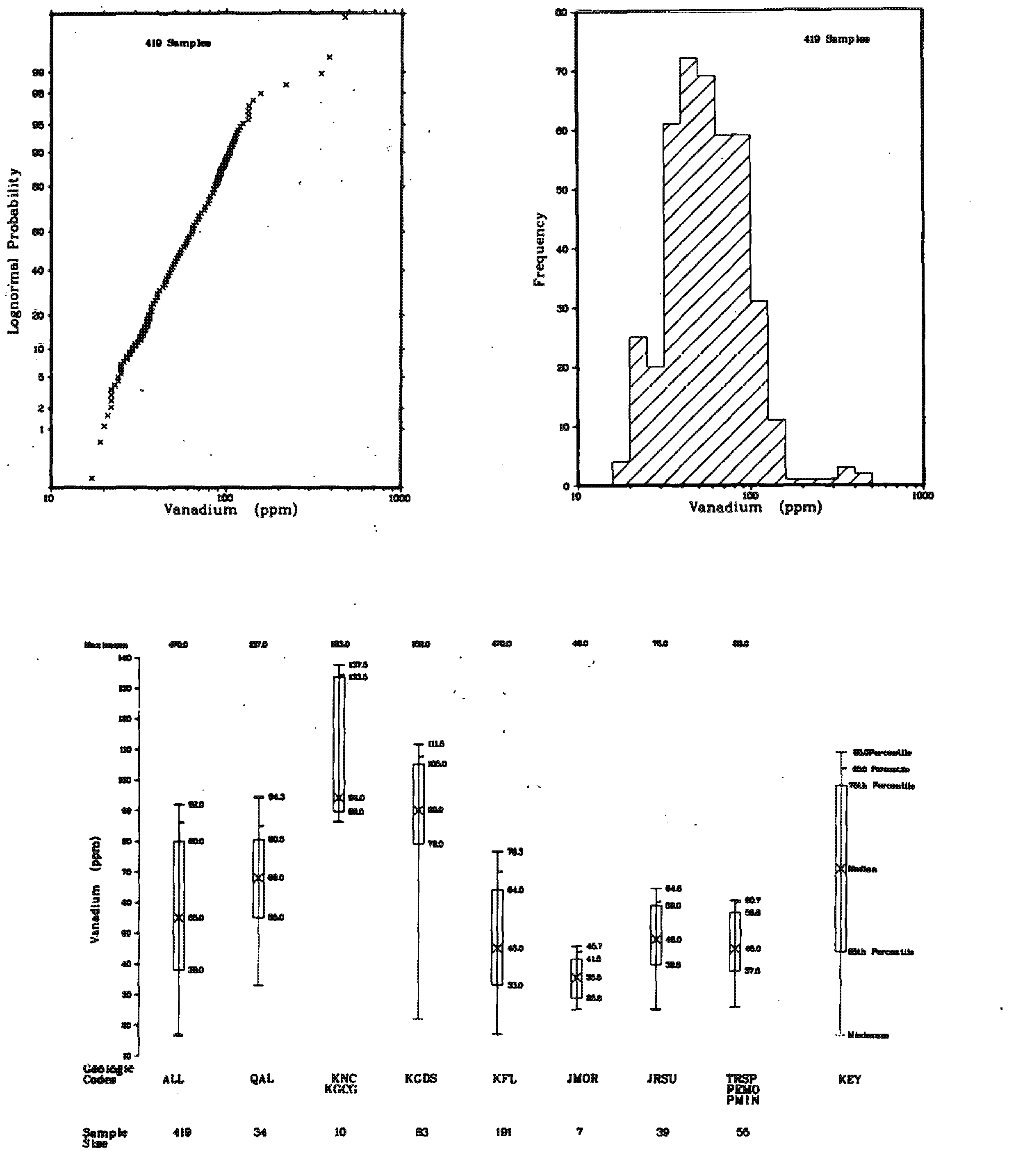
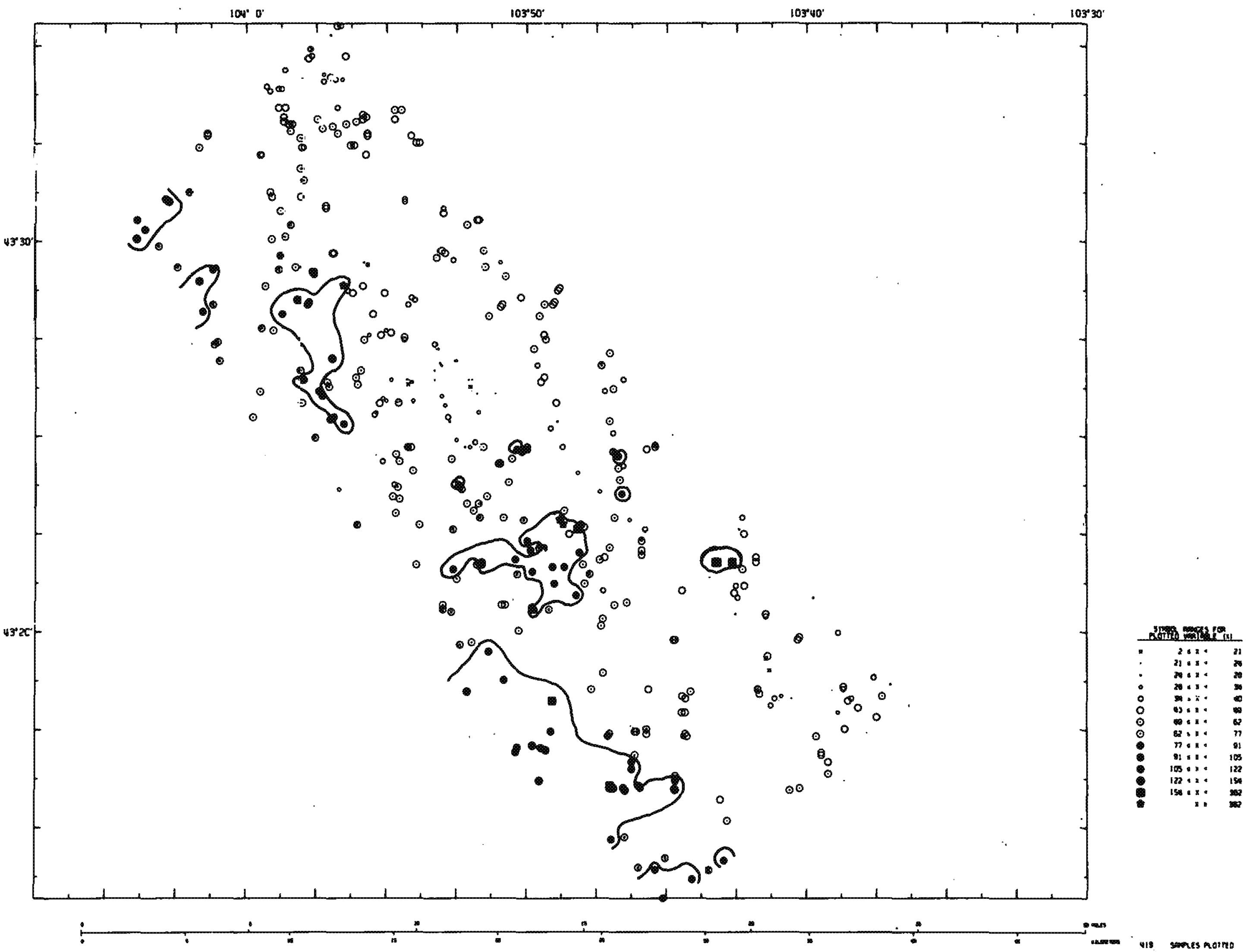


Figure B-23a

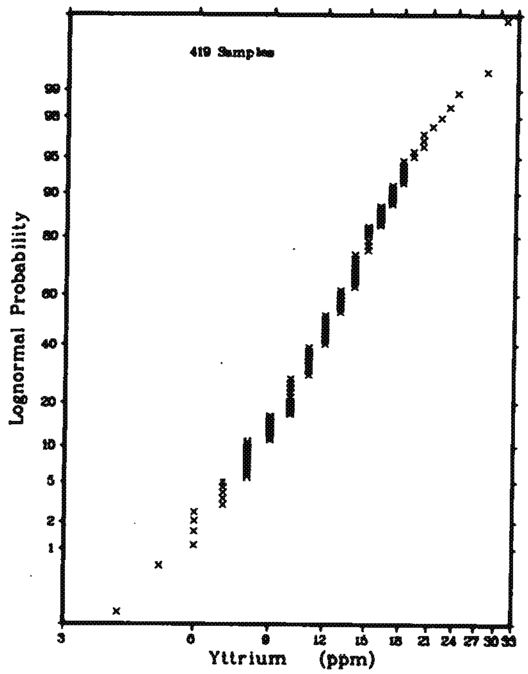
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR VANADIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

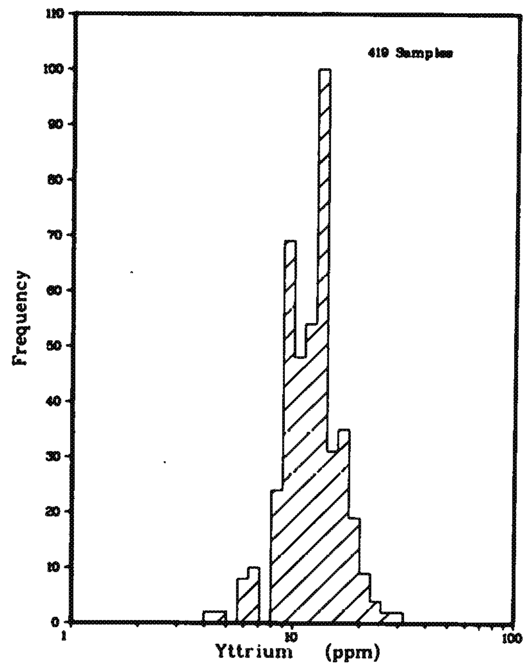


Approximate
Contour
≤91 ppm

Figure B-23b

GEOCHEMICAL DISTRIBUTION OF VANADIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





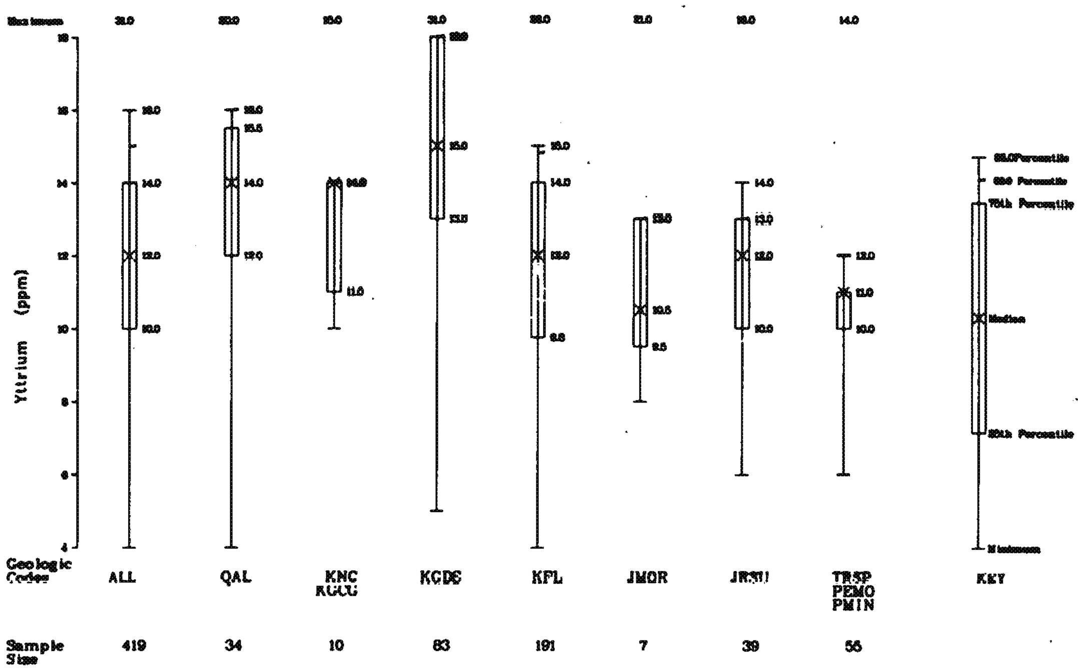
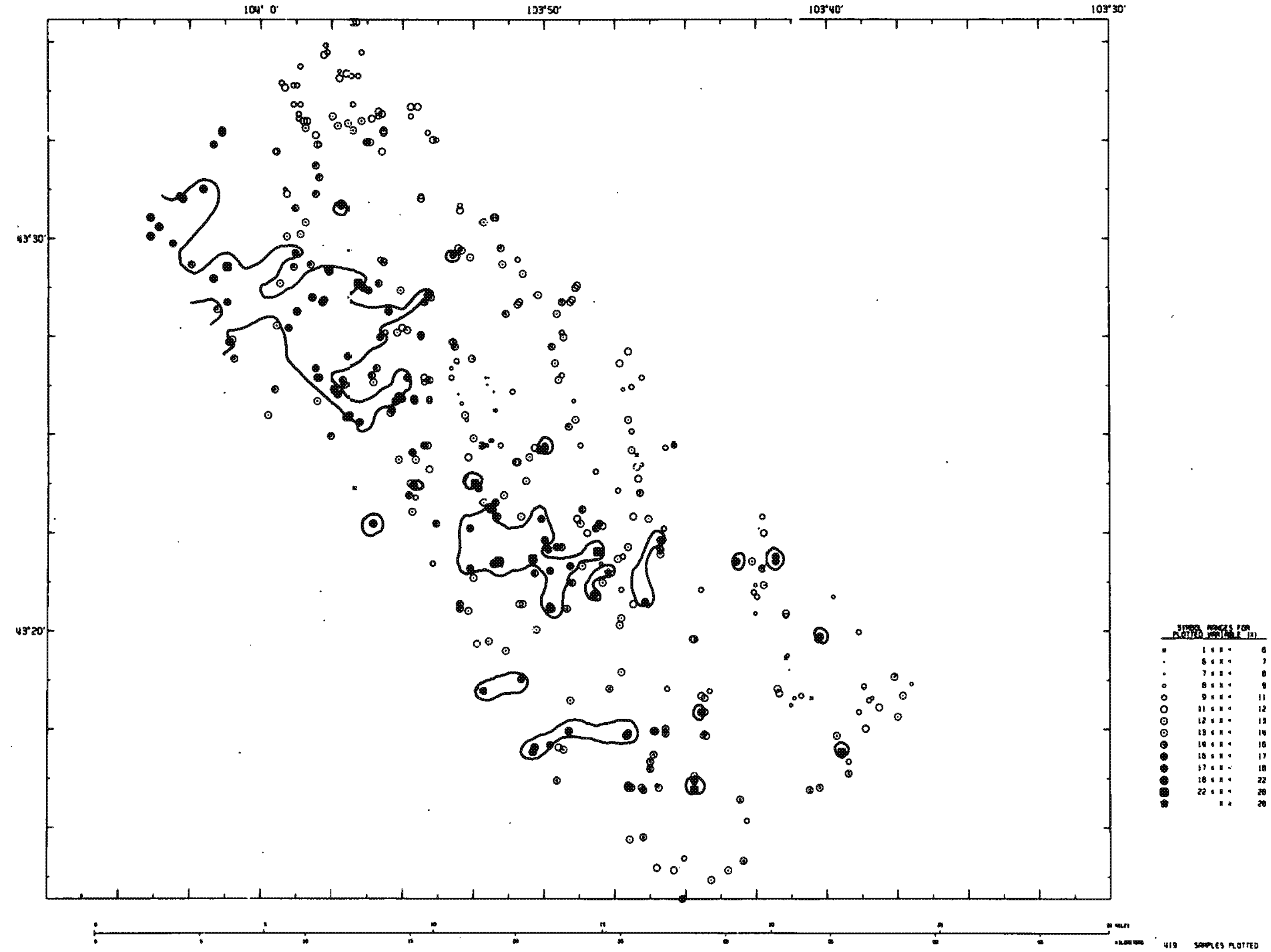


Figure B-24a

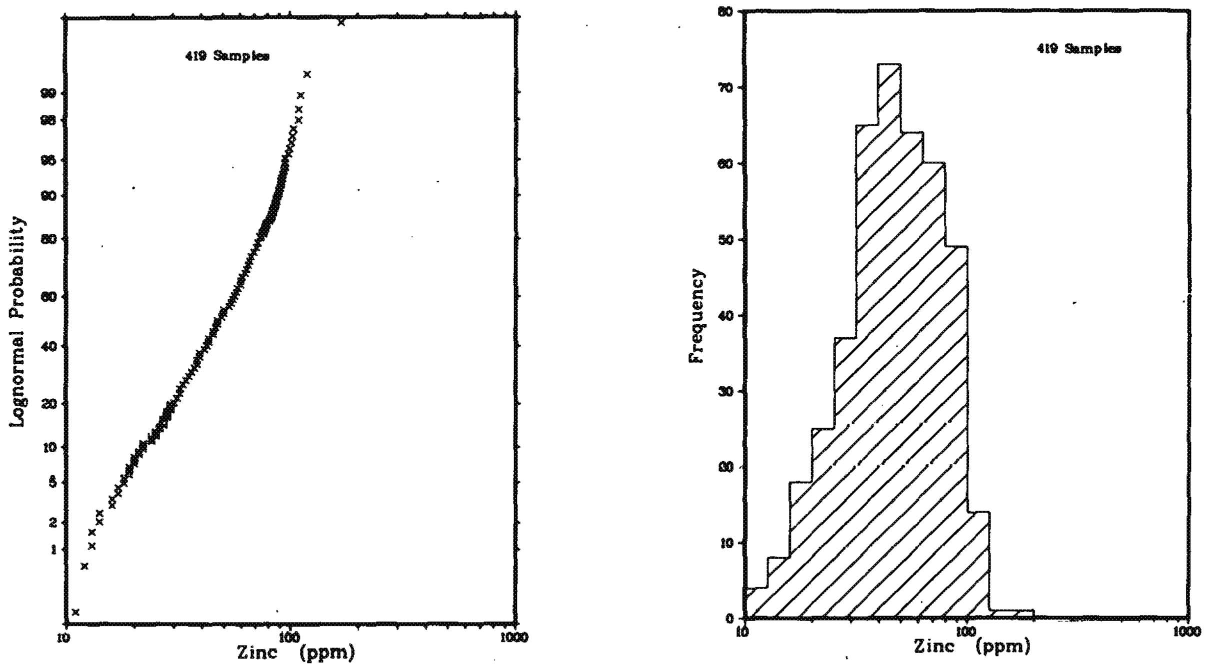
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR YTTRIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤16 ppm

Figure B-24b

GEOCHEMICAL DISTRIBUTION OF YTTRIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



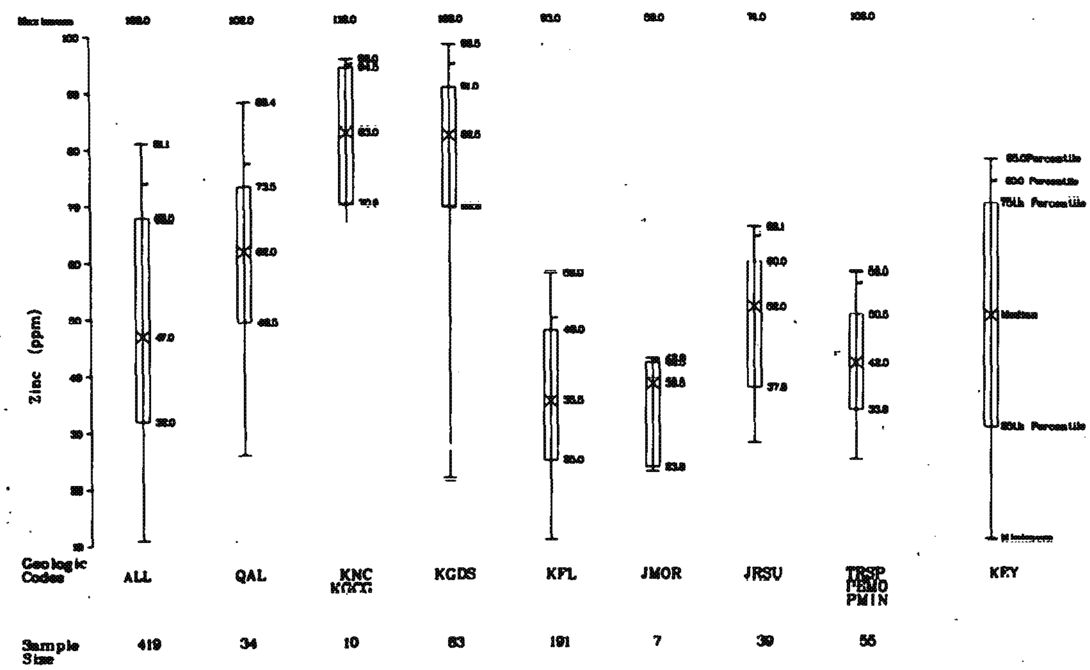
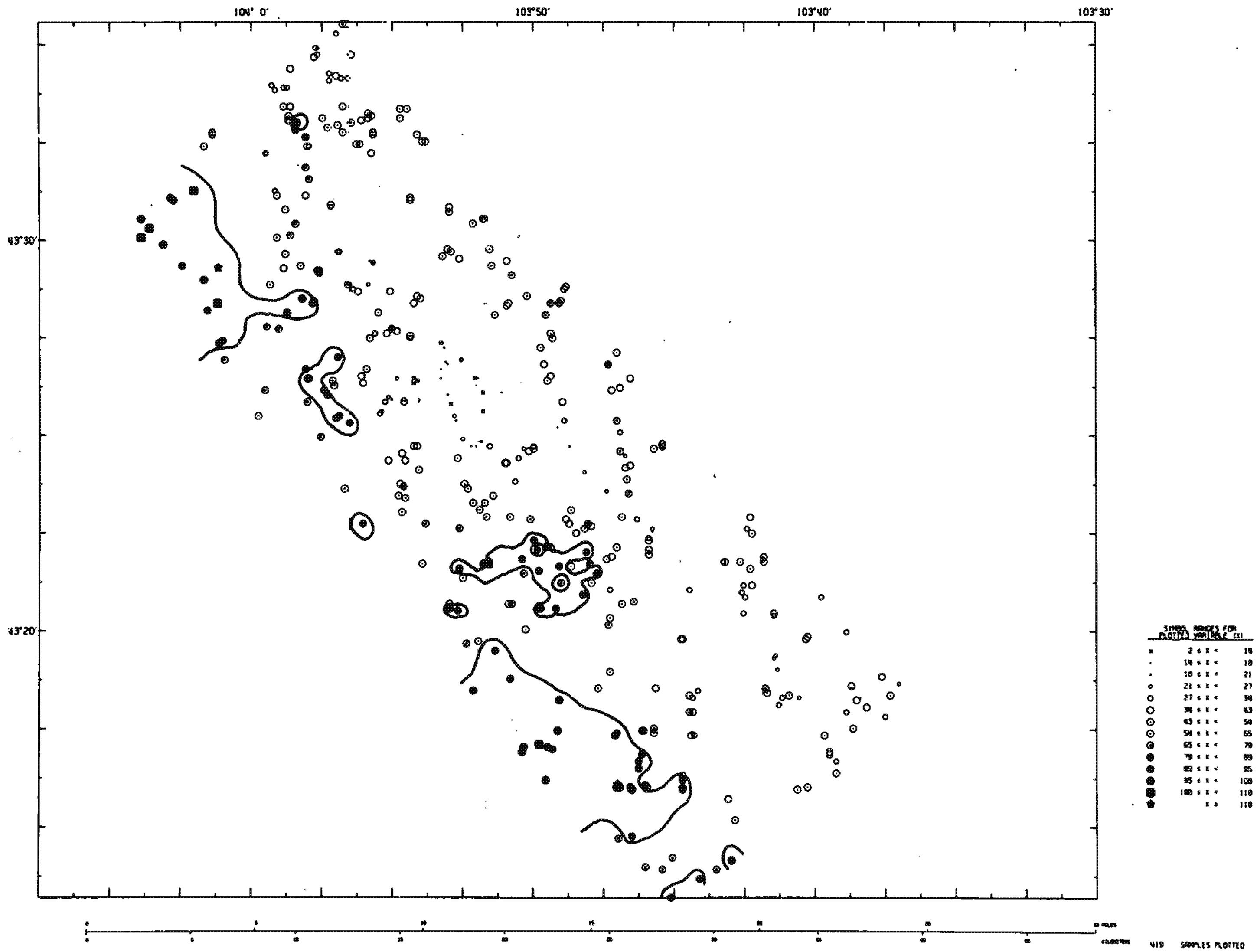


Figure B-25a

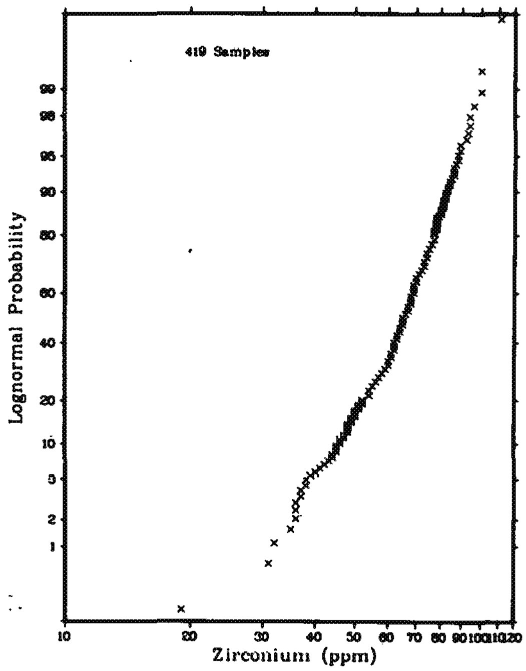
PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ZINC (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

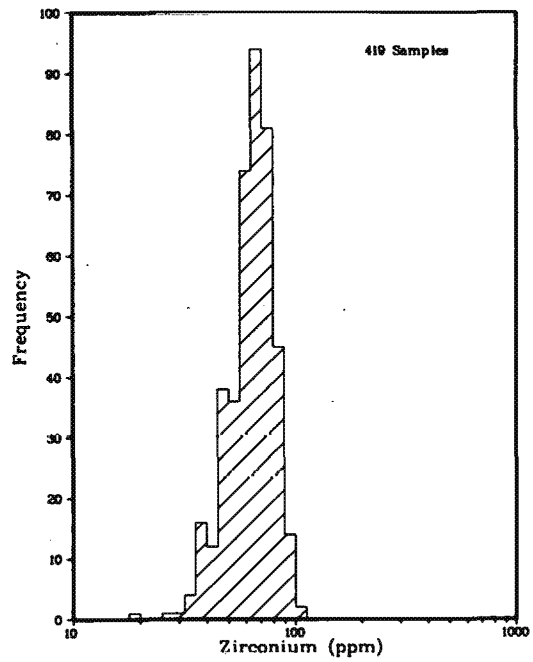


Approximate
Contour
≤79 ppm

Figure B-25b

GEOCHEMICAL DISTRIBUTION OF ZINC (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING





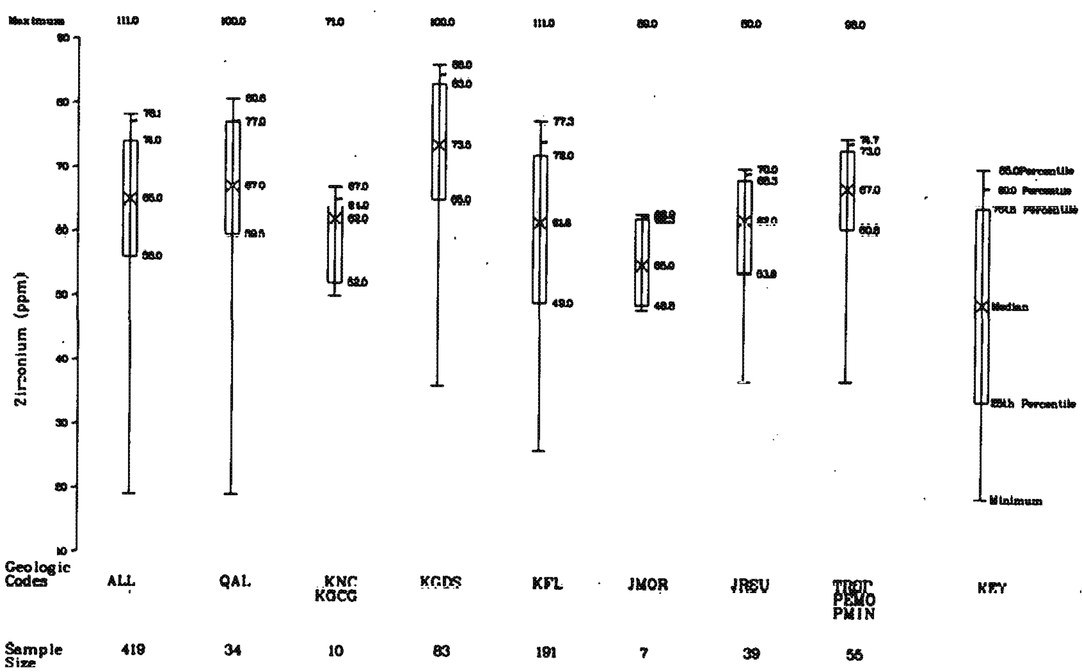
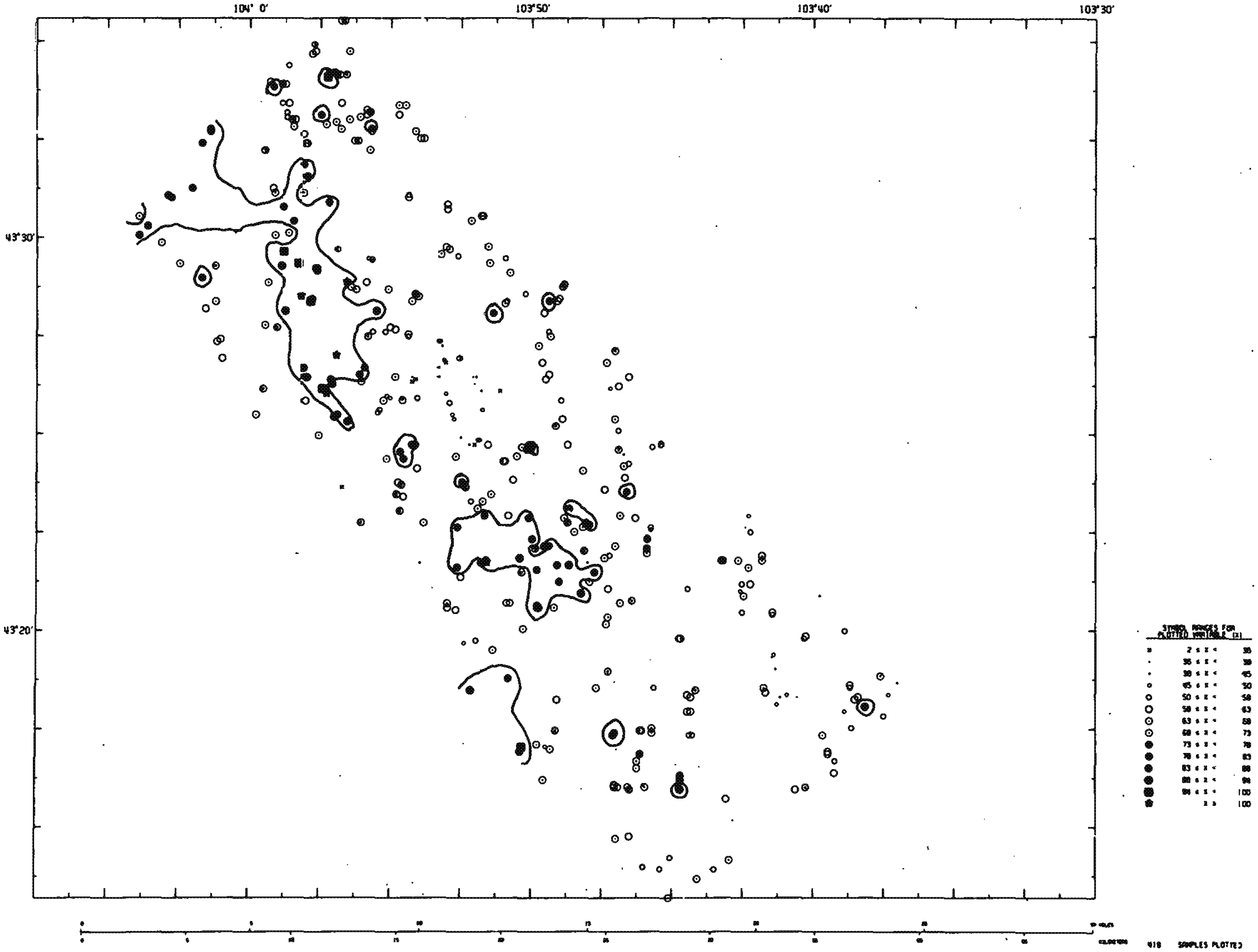


Figure B-26a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ZIRCONIUM (PPM)
IN STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING



Approximate
Contour
≤78 ppm

Figure B-26b

GEOCHEMICAL DISTRIBUTION OF ZIRCONIUM (PPM) IN STREAM SEDIMENT
OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

Table B-3

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. SAMPLE NUMBER ST LAT	LONG	L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CC (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
404876	46-43.376	-103.763	-3-15-	1.8	3.4	10	2.3	<4	5	6	0.4	23	20	47
404877	46-43.377	-103.763	-3-15-	2.0	3.1	2	3.5	5	8	9	0.6	34	24	56
404878	46-43.403	-103.779	-3-12-	4.0	4.6	8	2.6	6	13	16	3.0	54	46	69
404880	46-43.404	-103.776	-3-15-	4.8	5.1	8	2.7	<4	6	2	1.1	37	39	50
404881	46-43.408	-103.779	-3-15-	100.	92.	3	4.6	<4	5	3	7.2	110	22	40
404882	46-43.410	-103.782	-3-12-	6.3	6.8	4	5.5	11	23	27	12.	79	69	73
404883	46-43.418	-103.782	-3-15-	3.3	4.1	<2	2.8	<4	8	7	1.0	34	31	56
404884	46-43.423	-103.784	-3-15-	2.5	3.0	2	5.7	10	21	25	0.5	74	66	71
404885	46-43.441	-103.776	-3-15-	1.6	2.0	7	2.7	5	11	13	0.5	35	35	60
404886	46-43.452	-103.784	-3-15-	1.9	2.4	5	3.8	7	15	16	0.4	53	50	73
405071	46-43.488	-103.981	-3-15-	38.	38.	6	3.4	8	17	15	4.9	78	42	88
405072	46-43.489	-103.971	-3-15-	8.2	8.5	7	3.1	9	16	18	4.8	76	45	94
405073	46-43.475	-103.970	-3-15-	8.0	8.1	10	5.4	14	29	32	2.4	130	100	100
405074	46-43.473	-103.964	-3-15-	10.0	11.	4	5.3	12	27	25	3.1	100	86	96
405075	46-43.474	-103.963	-3-15-	4.3	4.8	6	3.2	12	21	25	2.8	96	60	87
405076	46-43.486	-103.960	-3-15-	5.0	5.2	8	4.0	11	22	24	1.1	85	78	86
405077	46-43.487	-103.960	-3-15-	3.5	3.9	7	3.2	12	17	17	1.4	64	50	81
405078	46-43.487	-103.961	-3-15-	32.	29.	5	4.7	7	14	14	7.6	83	34	75
405079	46-43.495	-103.948	-3-15-	3.1	4.2	2	17.	6	6	8	2.1	47	27	56
405080	46-43.495	-103.949	-3-15-	2.5	3.5	2	12.	6	8	9	1.8	47	28	49
405081	46-43.481	-103.943	-3-15-	57.	52.	18	14.	10	26	27	23.	470	72	110
405082	46-43.479	-103.940	-3-15-	2.7	3.7	4	2.4	4	9	8	1.4	39	32	66
405083	46-43.478	-103.937	-3-15-	3.5	3.5	5	3.1	5	11	9	0.8	47	39	67
405085	46-43.481	-103.931	-3-15-	5.7	6.9	3	4.8	<4	9	6	1.2	46	22	62
405086	46-43.490	-103.928	-3-15-	1.9	2.5	2	4.3	<4	6	4	2.5	30	24	49
405087	46-43.491	-103.928	-3-15-	1.8	2.0	3	2.8	<4	6	5	1.2	25	23	52
405088	46-43.491	-103.930	-3-15-	1.5	2.5	<2	3.3	5	12	5	0.6	22	20	46
405091	46-43.494	-103.980	-3-15-	2.9	3.9	4	4.0	8	17	18	0.3	80	50	94
405092	46-43.481	-103.989	-3-15-	0.70	2.7	7	4.0	8	16	21	0.2	62	55	70
405093	46-43.462	-103.984	-3-15-	3.7	4.4	9	6.6	9	20	19	0.1	71	72	77
405094	46-43.463	-103.991	-3-15-	5.3	3.4	5	5.2	10	22	26	0.3	81	75	68
405095	46-43.469	-103.979	-3-15-	2.2	3.0	7	4.7	12	23	26	0.2	100	100	92
405097	46-43.436	-103.992	-3-15-	2.1	3.2	6	3.3	6	18	14	0.2	71	65	77
405098	46-43.425	-103.996	-3-15-	2.5	3.2	6	4.0	7	15	16	0.3	68	61	63
405099	46-43.331	-103.671	-3-15-	3.1	3.0	4	3.8	8	16	15	0.4	66	60	60
405100	46-43.330	-103.672	-3-15-	1.6	2.6	3	4.0	6	13	9	1.0	46	43	55
405101	46-43.333	-103.648	-3-15-	1.3	1.6	3	1.7	4	8	8	0.4	34	31	51
405102	46-43.348	-103.663	-3-15-	1.4	1.5	2	2.7	<4	8	7	0.4	26	28	43
405208	46-43.339	-103.788	-3-15-	2.8	3.4	<2	4.1	8	16	21	0.5	66	60	68
405209	46-43.366	-103.765	-3-15-	2.3	3.3	6	3.2	8	14	15	0.2	54	43	69
405210	46-43.368	-103.765	-3-15-	2.4	3.6	7	3.0	7	15	13	0.4	54	49	77
405211	46-43.372	-103.765	-3-15-	2.5	3.6	6	4.0	11	15	21	0.3	63	62	74
405212	46-43.373	-103.765	-3-15-	1.3	2.2	5	3.8	30	6	16	0.1	29	32	46
405213	46-43.369	-103.784	-3-12-	5.2	4.9	6	4.1	9	17	20	0.8	66	59	68
405214	46-43.367	-103.802	-3-15-	6.2	22.	6	7.4	10	20	27	1.4	110	90	74
405216	46-43.362	-103.800	-3-15-	2.5	2.3	7	4.4	4	7	7	0.3	64	67	40
405217	46-43.364	-103.790	-3-15-	4.4	4.2	5	3.2	9	15	20	0.2	65	49	68
405218	46-43.365	-103.787	-3-15-	2.6	2.3	7	3.2	6	12	14	<0.1	43	40	57
405219	46-43.351	-103.788	-3-15-	3.0	3.0	3	2.6	5	10	10	<0.1	37	32	58
405220	46-43.305	-103.686	-3-15-	2.2	2.4	4	3.2	4	9	6	0.3	37	32	41
405221	46-43.323	-103.690	-3-15-	25.	39.	<2	3.1	<4	7	6	0.7	54	21	49
405222	46-43.306	-103.682	-3-15-	2.1	1.9	5	2.9	4	10	5	0.3	28	46	49
405223	46-43.307	-103.695	-3-15-	2.6	2.6	3	4.2	5	11	8	0.2	51	45	60
405224	46-43.302	-103.688	-3-15-	2.7	2.6	6	3.4	4	8	8	0.2	39	30	48
405226	46-43.358	-103.796	-3-15-	5.9	5.2	5	4.5	15	18	31	0.6	78	83	78

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. ST LAT	SAMPLE LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405227	46-43.349	-103.804	-3-15-	3.7	3.6	8	5.1	16	25	28	0.2	100	90	89
405228	46-43.346	-103.774	-3-15-	4.0	3.9	10	4.3	11	15	25	<0.1	74	73	74
405229	46-43.289	-103.785	-3-15-	5.9	5.6	11	7.6	10	21	27	0.5	83	98	86
405231	46-43.290	-103.784	-3-15-	5.6	4.8	11	7.2	7	20	21	0.6	90	88	87
405232	46-43.291	-103.768	-3-15-	5.9	5.4	8	2.8	8	17	15	0.2	72	69	62
405233	46-43.291	-103.769	-3-15-	3.3	3.4	9	3.9	6	12	13	0.1	53	53	72
405234	46-43.268	-103.767	-3-15-	11.	8.7	7	18.	27	16	46	1.0	90	74	43
405235	46-43.267	-103.766	-3-15-	6.2	5.8	10	11.	5	22	18	0.9	92	69	68
405236	46-43.267	-103.782	-3-15-	5.6	5.9	5	8.2	7	29	36	0.8	130	94	65
405237	46-43.268	-103.784	-3-15-	7.1	6.7	6	8.8	8	36	44	0.8	180	120	71
405238	46-43.267	-103.784	-3-15-	6.7	5.9	4	8.0	7	30	36	0.9	130	95	62
405239	46-43.267	-103.776	-3-15-	4.9	5.2	8	9.3	7	26	32	0.9	120	85	65
405240	46-43.266	-103.775	-3-15-	7.2	6.3	13	8.8	8	31	31	0.9	140	100	73
405241	46-43.275	-103.771	-3-15-	6.3	5.5	8	7.5	7	25	26	0.8	110	91	64
405242	46-43.278	-103.771	-3-15-	5.4	5.1	8	6.9	6	23	20	0.6	110	81	68
405243	46-43.281	-103.769	-3-15-	4.7	4.2	9	6.0	8	18	21	0.3	76	79	73
405244	46-43.292	-103.762	-3-15-	4.1	4.2	3	3.9	10	22	16	0.3	79	78	70
405245	46-43.290	-103.762	-3-15-	3.7	4.1	6	4.4	7	14	15	0.4	60	58	72
405246	46-43.291	-103.819	-3-12-	5.5	5.1	7	6.9	7	26	24	0.5	100	95	75
405247	46-43.368	-103.831	-3-15-	3.5	3.6	4	6.0	9	19	16	2.3	82	68	76
405248	46-43.369	-103.826	-3-15-	4.1	3.8	7	3.4	8	18	20	1.2	85	93	75
405249	46-43.369	-103.823	-3-15-	4.5	4.2	9	4.2	9	19	19	1.1	91	71	81
405250	46-43.361	-103.818	-3-15-	5.4	4.8	8	4.8	9	22	24	0.8	96	86	81
405251	46-43.361	-103.811	-3-15-	6.0	4.8	5	4.9	6	21	13	1.2	110	56	93
405252	46-43.354	-103.817	-3-15-	4.0	4.3	10	5.2	6	22	16	1.7	110	65	86
405253	46-43.372	-103.833	-3-15-	3.8	4.2	12	4.5	9	19	20	0.9	92	79	78
405254	46-43.343	-103.820	-3-15-	2.9	3.4	6	3.2	9	19	20	1.2	88	81	71
405255	46-43.359	-103.830	-3-15-	2.5	3.0	7	4.5	9	20	20	0.9	100	83	81
405256	46-43.343	-103.829	-3-15-	4.4	3.6	9	4.5	11	20	21	1.2	80	74	80
405257	46-43.344	-103.830	-3-15-	2.9	3.6	10	6.4	12	21	22	0.8	76	78	82
405258	46-43.343	-103.830	-3-15-	2.6	3.6	10	4.9	9	20	21	0.4	79	87	79
405259	46-43.364	-103.840	-3-15-	2.9	3.4	11	4.8	9	21	21	0.1	93	85	89
405260	46-43.362	-103.860	-3-15-	2.6	3.1	11	5.1	13	22	31	0.1	110	120	100
405261	46-43.363	-103.860	-3-15-	3.2	3.1	4	2.9	10	16	25	0.7	91	82	84
405263	46-43.282	-103.840	-3-12-	4.4	5.2	10	6.6	6	25	20	1.4	110	95	83
405264	46-43.284	-103.839	-3-12-	6.2	6.7	12	8.0	7	28	23	0.8	120	100	94
405265	46-43.270	-103.826	-3-15-	7.0	6.7	9	11.	7	31	36	0.9	140	97	69
405266	46-43.284	-103.825	-3-12-	6.9	6.0	7	17.	11	22	31	13.	120	88	48
405267	46-43.283	-103.822	-3-12-	7.2	7.2	13	7.7	7	26	29	2.3	130	91	67
405268	46-43.285	-103.830	-3-15-	5.8	5.7	7	11.	12	28	31	1.8	150	110	64
405269	46-43.345	-103.848	-3-15-	2.7	3.6	9	4.6	6	12	13	0.6	61	57	62
405270	46-43.345	-103.846	-3-15-	6.1	5.9	8	5.1	8	16	18	0.9	63	77	60
405271	46-43.325	-103.856	-3-15-	4.8	5.1	11	7.3	7	20	24	0.7	110	89	67
405276	46-43.328	-103.873	-3-15-	3.1	3.7	8	5.6	5	14	18	0.8	80	65	49
405278	46-43.329	-103.866	-3-12-	4.3	4.2	5	5.5	5	12	18	0.4	75	57	50
405279	46-43.313	-103.847	-3-15-	7.4	6.3	8	9.7	7	26	25	1.4	120	92	81
405280	46-43.308	-103.869	-3-15-	8.3	7.8	9	11.	8	29	25	1.6	130	94	88
405281	46-43.316	-103.788	-3-15-	2.7	2.7	<2	4.4	6	13	16	<0.1	55	49	74
405282	46-43.309	-103.761	-3-15-	2.8	3.2	4	3.6	5	10	11	1.7	45	41	54
405283	46-43.309	-103.795	-3-12-	3.5	3.5	6	3.6	7	15	15	1.2	69	62	67
405284	46-43.356	-103.675	-3-15-	3.1	3.1	4	3.6	6	13	13	2.6	62	57	59
405285	46-43.304	-103.818	-3-12-	16.	14.	6	9.9	9	35	32	6.4	220	99	60
405313	46-43.360	-103.705	-3-15-	3.4	3.0	9	4.8	6	14	14	1.0	61	57	70
405314	46-43.365	-103.697	-3-15-	2.9	3.2	3	3.9	11	12	19	0.9	40	49	65
405315	46-43.363	-103.697	-3-15-	3.1	3.1	8	4.1	10	12	13	0.9	45	47	69

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405316	46-43.363	-103.711	-3-12-	77.	77.	7	11.	7	14	13	1.8	160	48	69
405317	46-43.353	-103.704	-3-15-	2.3	2.8	6	5.6	4	9	10	0.6	40	34	61
405318	46-43.348	-103.708	-3-15-	3.3	3.2	6	2.1	4	9	7	0.4	38	29	64
405319	46-43.353	-103.709	-3-15-	2.8	2.5	7	5.2	4	11	8	0.5	36	33	50
405320	46-43.350	-103.710	-3-15-	1.4	2.2	5	2.1	4	8	9	0.7	40	30	48
405322	46-43.341	-103.709	-3-15-	2.0	2.5	2	2.4	<4	7	6	<0.1	27	27	52
405323	46-43.363	-103.721	-3-15-	130.	110.	11	14.	4	11	12	8.8	260	29	67
405324	46-43.363	-103.720	-3-15-	170.	150.	9	23.	6	16	14	26.	350	52	74
405325	46-43.322	-103.691	-3-15-	2.3	2.1	3	2.6	<4	4	3	2.4	17	25	36
405326	46-43.317	-103.689	-3-15-	2.1	1.9	5	2.9	<4	7	6	0.4	20	24	42
405327	46-43.305	-103.676	-3-15-	4.3	4.7	4	2.0	<4	5	4	0.5	22	22	36
405329	46-43.309	-103.696	-3-15-	2.3	2.6	9	2.3	7	14	19	0.2	77	70	72
405331	46-43.345	-103.781	-3-12-	3.4	4.3	5	3.1	6	14	17	0.7	58	60	64
405332	46-43.354	-103.799	-3-15-	2.9	3.3	7	4.4	7	17	19	0.6	70	64	67
405333	46-43.336	-103.789	-3-15-	2.8	3.2	7	3.9	8	16	19	0.6	70	65	64
405334	46-43.375	-103.704	-3-15-	2.3	2.2	6	3.5	4	14	7	0.1	40	55	52
405335	46-43.377	-103.707	-3-15-	2.0	2.1	3	2.4	<4	7	9	0.7	25	29	37
405336	46-43.382	-103.705	-3-15-	2.0	1.9	2	1.8	<4	10	8	0.2	35	39	48
405337	46-43.289	-103.738	-3-15-	2.3	3.0	7	3.2	4	8	7	0.8	46	32	51
405338	46-43.290	-103.739	-3-15-	1.5	2.3	3	1.9	<4	7	6	0.4	48	21	39
405339	46-43.289	-103.740	-3-15-	2.6	3.0	7	3.3	4	7	8	0.7	37	35	51
405340	46-43.299	-103.739	-3-15-	3.9	4.0	5	4.2	5	11	11	1.2	51	47	66
405341	46-43.299	-103.741	-3-15-	32.	32.	7	6.5	8	14	14	0.9	65	72	68
405342	46-43.308	-103.736	-3-15-	3.6	3.9	5	8.3	4	10	9	1.9	51	28	73
405343	46-43.306	-103.741	-3-15-	2.3	3.2	7	3.9	5	10	10	0.9	51	46	62
405344	46-43.305	-103.739	-3-15-	3.1	4.2	4	7.1	4	9	7	1.1	46	30	65
405345	46-43.330	-103.746	-3-15-	11.	11.	7	9.5	6	10	10	3.4	58	35	62
405346	46-43.330	-103.745	-3-15-	15.	14.	4	12.	6	12	10	3.8	70	38	64
405347	46-43.266	-103.677	-3-15-	4.0	3.6	9	4.9	6	15	14	1.1	66	62	62
405348	46-43.281	-103.658	-3-15-	2.5	3.0	5	3.2	5	10	10	0.5	45	42	59
405349	46-43.278	-103.654	-3-15-	6.0	6.2	5	3.4	4	6	8	0.5	43	32	51
405350	46-43.292	-103.644	-3-15-	3.5	3.2	9	3.3	5	10	9	0.8	48	45	52
405351	46-43.334	-103.638	-3-15-	2.2	3.3	6	2.2	6	11	14	0.7	52	51	64
405352	46-43.358	-103.639	-3-15-	2.6	3.3	9	4.2	10	18	21	0.8	81	70	77
405353	46-43.362	-103.663	-3-15-	2.4	3.0	7	4.1	9	16	20	1.1	83	78	75
405354	46-43.351	-103.741	-3-15-	3.7	5.1	7	8.5	6	9	11	1.3	47	30	56
405358	46-43.340	-103.691	-3-15-	4.3	3.9	5	3.2	4	8	6	1.1	39	27	55
405359	46-43.341	-103.691	-3-15-	2.4	2.8	3	4.5	4	11	8	1.2	40	42	61
405360	46-43.588	-103.550	-3-15-	1.4	1.7	3	2.2	<4	7	7	0.3	26	27	37
405361	46-43.579	-103.561	-3-15-	2.0	2.1	3	2.7	5	10	13	0.1	38	30	58
405362	46-43.578	-103.563	-3-12-	1.9	2.1	3	3.2	5	12	13	1.2	42	34	72
405363	46-43.582	-103.562	-3-12-	1.5	1.8	2	2.4	4	9	10	0.4	34	27	52
405364	46-43.582	-103.561	-3-15-	1.5	2.0	2	1.9	<4	9	9	0.4	32	25	48
405365	46-43.579	-103.541	-3-15-	2.9	2.7	6	2.9	6	11	14	<0.1	45	41	71
405366	46-43.569	-103.543	-3-15-	2.2	2.3	3	2.4	4	8	12	0.1	33	27	75
405367	46-43.570	-103.550	-3-15-	3.1	2.8	5	2.6	6	12	16	0.2	44	39	77
405368	46-43.569	-103.547	-3-15-	2.7	2.4	6	3.3	4	8	12	0.4	35	28	76
405369	46-43.310	-103.645	-3-15-	3.0	3.3	7	3.2	5	11	10	1.0	46	34	63
405370	46-43.309	-103.645	-3-15-	3.5	3.3	2	3.5	4	7	6	0.5	35	19	50
405371	46-43.305	-103.640	-3-15-	3.4	3.1	6	2.8	4	7	6	0.4	36	20	64
405372	46-43.304	-103.642	-3-15-	3.3	3.4	6	2.5	4	8	8	1.0	46	38	60
405373	46-43.301	-103.636	-3-15-	3.6	4.1	8	2.6	<4	7	7	0.6	44	34	93
405374	46-43.297	-103.625	-3-15-	1.9	2.8	7	2.6	5	8	9	2.1	41	32	56
405375	46-43.306	-103.622	-3-15-	1.9	4.6	11	2.9	5	10	13	1.7	53	50	46
405376	46-43.315	-103.626	-3-15-	1.1	1.6	3	1.5	<4	7	9	0.2	21	17	37

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405377	46-43.314	-103.627	-3-15-	1.9	2.7	9	2.2	<4	11	8	1.2	39	41	68
405378	46-43.311	-103.617	-3-15-	1.8	2.0	3	2.2	<4	7	5	0.6	26	25	43
405419	46-43.393	-103.790	-3-15-	4.7	5.3	<2	3.3	7	13	8	0.3	31	21	61
405420	46-43.401	-103.803	-3-15-	1.2	2.4	8	2.1	6	9	7	0.4	28	26	66
405421	46-43.412	-103.812	-3-15-	17.	16.	3	4.3	6	8	6	1.4	35	19	61
405423	46-43.420	-103.819	-3-15-	6.9	6.4	<2	3.2	5	9	5	0.9	34	14	73
405424	46-43.423	-103.815	-3-15-	2.8	3.2	3	2.0	5	8	5	0.4	27	27	60
405425	46-43.381	-103.772	-3-15-	4.1	3.2	2	2.7	6	11	7	0.6	33	27	61
405426	46-43.382	-103.781	-3-12-	5.0	6.7	8	4.2	9	16	21	2.4	69	60	69
405427	46-43.392	-103.777	-3-15-	9.9	11.	5	3.2	9	16	17	1.2	100	74	78
405428	46-43.398	-103.778	-3-15-	4.5	5.8	5	4.2	9	16	21	2.6	70	60	62
405429	46-43.412	-103.757	-3-15-	1.2	1.8	3	2.7	10	13	16	<0.1	68	64	57
405430	46-43.412	-103.757	-3-15-	1.5	1.9	5	1.5	4	8	6	0.1	30	28	51
405431	46-43.413	-103.757	-3-15-	2.2	2.2	2	1.9	5	10	11	0.4	36	38	48
405432	46-43.411	-103.762	-3-15-	2.2	2.5	6	2.6	6	11	13	0.2	48	45	50
405433	46-43.447	-103.789	-3-15-	2.5	3.0	5	4.5	11	20	27	0.2	86	84	65
405434	46-43.436	-103.787	-3-15-	1.5	2.0	4	1.5	5	8	9	<0.1	35	34	49
405435	46-43.437	-103.782	-3-15-	1.8	2.4	6	4.1	6	13	17	0.6	50	41	58
405436	46-43.431	-103.816	-3-15-	2.4	2.8	4	2.2	4	8	7	0.4	40	37	53
405437	46-43.440	-103.825	-3-15-	2.4	2.9	5	2.6	5	10	10	0.4	41	47	59
405438	46-43.442	-103.823	-3-15-	2.8	2.5	3	1.6	5	8	11	0.2	41	38	59
405439	46-43.447	-103.827	-3-15-	2.4	2.6	4	3.1	5	10	10	0.7	39	34	62
405440	46-43.454	-103.829	-3-15-	2.3	2.8	4	2.1	5	12	11	0.5	51	53	70
405441	46-43.458	-103.822	-3-15-	2.4	2.5	4	1.7	5	12	11	0.4	49	54	63
405442	46-43.460	-103.823	-3-15-	1.9	2.2	3	1.7	5	11	10	0.3	42	47	54
405443	46-43.476	-103.837	-3-15-	2.5	2.4	3	1.6	5	12	10	0.7	46	60	57
405444	46-43.473	-103.823	-3-15-	2.0	2.4	6	2.5	8	14	17	0.6	75	74	79
405445	46-43.473	-103.818	-3-15-	3.2	3.9	10	4.3	10	19	24	0.6	75	68	70
405446	46-43.474	-103.817	-3-15-	1.8	2.2	8	1.6	9	16	15	0.8	60	46	60
405447	46-43.480	-103.814	-3-15-	3.8	4.3	8	3.6	8	14	19	0.5	55	49	74
405448	46-43.479	-103.815	-3-15-	1.9	2.4	6	3.3	7	12	18	0.3	49	45	73
405449	46-43.468	-103.826	-3-15-	5.2	5.7	3	1.5	6	15	14	0.7	53	74	62
405450	46-43.382	-103.861	-3-15-	3.7	3.8	6	3.5	7	19	16	0.5	80	63	86
405451	46-43.385	-103.865	-3-15-	4.5	4.7	8	2.5	8	16	15	0.9	69	64	70
405452	46-43.397	-103.844	-3-15-	3.8	4.6	5	3.5	7	11	12	1.0	55	31	60
405453	46-43.394	-103.872	-3-15-	11.	12.	5	2.9	8	14	19	0.8	77	43	75
405454	46-43.396	-103.874	-3-15-	4.9	6.1	9	3.8	10	20	23	0.6	99	61	93
405455	46-43.412	-103.870	-3-15-	0.98	1.8	5	1.5	<4	7	4	0.6	25	17	38
405457	46-43.414	-103.864	-3-15-	3.4	4.2	3	2.6	<4	6	5	1.1	37	19	45
405458	46-43.427	-103.863	-3-15-	2.5	3.4	3	2.2	<4	5	4	1.2	22	12	44
405459	46-43.435	-103.863	-3-15-	2.3	8.8	2	1.8	<4	6	3	0.4	23	13	38
405460	46-43.438	-103.867	-3-15-	1.5	1.8	<2	1.3	<4	6	3	<0.1	19	17	37
405461	46-43.441	-103.866	-3-15-	2.0	1.8	<2	1.6	<4	6	2	0.7	23	14	38
405462	46-43.441	-103.868	-3-15-	0.87	2.1	<2	1.5	<4	6	3	0.8	22	11	36
405463	46-43.415	-103.875	-3-15-	1.4	2.4	<2	2.1	<4	7	8	0.8	30	26	44
405464	46-43.430	-103.882	-3-15-	16.	17.	4	2.0	<4	6	6	0.6	32	13	53
405465	46-43.434	-103.884	-3-15-	1.5	2.0	<2	2.4	<4	5	6	0.4	30	18	45
405466	46-43.447	-103.884	-3-15-	1.6	2.0	<2	2.8	<4	5	5	0.5	24	17	31
405467	46-43.449	-103.875	-3-15-	1.7	2.2	2	4.1	<4	5	4	0.5	25	14	35
405468	46-43.456	-103.888	-3-15-	1.5	2.6	<2	5.8	4	8	6	0.5	36	25	45
405469	46-43.456	-103.887	-3-15-	1.5	2.1	5	3.3	4	7	7	0.1	25	19	49
405470	46-43.468	-103.856	-3-15-	2.8	2.8	9	4.0	5	13	9	0.4	49	47	78
405471	46-43.472	-103.849	-3-15-	1.9	2.3	8	2.4	5	10	9	0.4	43	42	70
405472	46-43.473	-103.848	-3-15-	1.4	1.9	5	1.7	5	11	10	0.4	43	45	57
405473	46-43.485	-103.846	-3-15-	1.8	2.5	5	1.8	6	16	14	0.6	64	66	65

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405474	46-43.491	-103.849	-3-15-	1.1	1.8	<2	0.8	<4	7	7	0.2	32	34	54
405475	46-43.489	-103.858	-3-15-	1.7	2.1	5	2.3	6	12	13	0.1	59	54	68
405476	46-43.496	-103.859	-3-15-	1.6	2.1	7	1.7	5	13	13	0.3	53	60	69
405477	46-43.495	-103.882	-3-15-	2.4	2.7	4	2.7	6	13	13	0.4	59	60	65
405478	46-43.496	-103.884	-3-15-	2.8	2.9	6	2.4	5	11	11	0.8	50	51	64
405479	46-43.493	-103.887	-3-15-	2.9	2.8	6	2.1	6	13	12	0.8	60	58	69
405480	46-43.492	-103.877	-3-15-	1.6	1.9	3	2.0	4	8	8	0.6	39	36	57
405481	46-43.441	-103.914	-3-15-	1.7	1.7	6	1.4	<4	8	5	0.4	28	21	71
405482	46-43.433	-103.919	-3-15-	1.3	1.9	5	1.7	<4	9	6	3.0	28	21	48
405483	46-43.432	-103.917	-3-15-	1.3	1.8	2	1.5	<4	8	4	0.9	29	20	48
405484	46-43.432	-103.910	-3-15-	1.1	1.9	3	1.6	<4	7	5	0.6	30	22	47
405485	46-43.441	-103.904	-3-15-	0.85	1.3	4	1.6	<4	6	4	0.5	21	13	36
405486	46-43.439	-103.904	-3-15-	0.89	1.0	2	1.3	<4	5	5	0.6	18	11	26
405488	46-43.440	-103.901	-3-15-	1.5	1.3	3	1.1	<4	6	3	0.3	22	14	36
405489	46-43.440	-103.902	-3-15-	1.1	1.5	2	1.1	<4	6	5	0.2	19	12	32
405490	46-43.432	-103.901	-3-15-	1.6	1.8	8	1.2	<4	7	5	0.1	29	19	51
405491	46-43.431	-103.901	-3-15-	0.91	1.6	4	1.8	<4	6	4	1.5	22	16	36
405492	46-43.431	-103.910	-3-15-	1.9	2.5	3	1.7	4	12	7	1.0	45	35	66
405493	46-43.431	-103.921	-3-15-	2.0	2.1	4	1.6	<4	11	5	0.1	43	29	68
405494	46-43.426	-103.924	-3-15-	1.2	2.1	5	1.6	<4	9	6	0.4	34	28	53
405495	46-43.427	-103.923	-3-15-	1.2	1.8	7	2.2	<4	10	6	0.7	33	26	54
405496	46-43.409	-103.911	-3-15-	2.5	3.2	7	2.7	8	15	13	0.6	59	39	80
405497	46-43.406	-103.909	-3-15-	2.5	3.3	6	3.1	7	15	15	<0.1	60	41	78
405498	46-43.412	-103.904	-3-15-	3.1	4.0	7	2.7	7	19	17	0.5	85	55	84
405499	46-43.412	-103.902	-3-15-	2.9	3.3	7	3.4	8	14	15	0.5	58	45	77
405500	46-43.402	-103.901	-3-15-	2.3	2.8	5	3.1	8	14	15	0.3	50	44	60
405501	46-43.360	-103.877	-3-15-	2.8	3.7	12	8.6	9	23	21	0.5	92	87	83
405502	46-43.377	-103.877	-3-15-	2.6	3.1	5	5.1	10	18	21	0.1	79	76	78
405503	46-43.379	-103.897	-3-15-	2.8	3.3	3	4.0	8	14	16	0.1	55	66	64
405504	46-43.416	-103.959	-3-12-	3.5	4.3	7	4.0	6	20	16	0.5	84	76	65
405505	46-43.424	-103.950	-3-15-	3.8	3.9	8	4.7	7	22	21	0.4	88	83	77
405506	46-43.422	-103.942	-3-15-	5.1	4.8	8	5.0	10	24	24	0.8	99	89	88
405507	46-43.425	-103.948	-3-15-	4.4	4.4	5	5.7	10	24	24	0.1	95	92	85
405508	46-43.343	-103.883	-3-15-	6.6	7.9	10	6.6	8	22	23	0.9	86	95	62
405509	46-43.349	-103.883	-3-15-	2.7	3.7	8	3.4	6	14	15	0.3	67	63	69
405510	46-43.342	-103.878	-3-15-	15.	14.	9	4.5	5	20	17	1.0	89	87	61
405511	46-43.379	-103.934	-3-15-	4.0	4.2	11	5.3	6	23	19	0.6	86	84	77
405512	46-43.394	-103.945	-3-12-	3.0	3.8	5	1.5	<4	10	7	0.9	33	60	19
405513	46-43.362	-103.899	-3-12-	2.6	3.6	6	3.1	4	9	9	0.3	51	48	44
405515	46-43.449	-104.016	-3-12-	3.0	4.0	8	4.4	8	18	22	0.2	85	77	61
405516	46-43.457	-104.017	-3-12-	4.1	4.0	9	5.5	11	22	26	0.7	83	79	66
405517	46-43.456	-104.019	-3-12-	4.5	5.0	8	6.5	10	18	23	1.0	85	90	67
405518	46-43.473	-104.020	-3-12-	4.4	5.3	8	8.4	12	19	27	1.6	85	110	65
405519	46-43.470	-104.026	-3-15-	4.1	4.6	10	7.6	7	28	28	1.8	110	88	60
405520	46-43.483	-104.028	-3-12-	5.2	5.9	9	4.7	9	24	24	0.6	120	99	85
405521	46-43.489	-104.041	-3-12-	3.7	4.5	9	6.4	11	18	23	1.2	90	89	69
405522	46-43.488	-104.020	-3-15-	5.5	6.5	9	17.	16	31	42	1.5	100	170	77
405523	46-43.540	-104.028	-3-15-	3.5	3.9	7	5.8	8	19	16	0.6	73	50	82
405524	46-43.546	-104.023	-3-15-	3.5	3.8	6	5.2	7	18	12	0.5	57	43	80
405525	46-43.545	-104.023	-3-15-	4.3	4.4	6	5.4	5	14	10	0.7	57	44	78
405526	46-43.518	-104.048	-3-12-	6.5	5.9	9	6.0	5	22	14	0.2	110	84	78
405527	46-43.517	-104.046	-3-12-	7.4	8.0	9	6.6	12	25	22	0.5	120	100	82
405528	46-43.509	-104.065	-3-15-	3.4	4.0	7	6.8	12	20	25	0.9	93	99	70
405529	46-43.501	-104.065	-3-15-	6.3	6.5	10	6.9	9	28	31	0.9	130	110	86
405530	46-43.505	-104.060	-3-15-	4.6	5.1	6	6.7	9	24	24	0.4	110	110	85

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. C. E. ST LAT	SAMPLE LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405531	46-43.498	-104.052	-3-12-	3.8	4.2	8	8.0	10	19	24	1.0	89	95	63
405532	46-43.521	-104.034	-3-15-	5.9	6.3	11	9.4	11	23	29	0.9	89	110	84
405533	46-43.478	-103.918	-3-15-	3.1	3.2	4	4.8	5	11	10	0.6	46	42	63
405534	46-43.462	-103.917	-3-15-	2.0	2.3	2	3.9	4	9	7	2.1	32	65	58
405535	46-43.461	-103.914	-3-15-	2.1	2.4	5	4.9	5	11	9	0.8	43	37	60
405536	46-43.459	-103.906	-3-15-	3.3	3.5	7	5.2	9	16	19	2.2	64	48	70
405537	46-43.458	-103.906	-3-15-	2.2	2.2	2	5.4	4	11	7	0.6	36	32	52
405538	46-43.473	-103.904	-3-15-	2.6	2.7	2	3.8	5	11	9	0.5	37	38	72
405539	46-43.476	-103.902	-3-15-	2.4	2.7	<2	3.3	4	11	8	0.4	37	41	77
405540	46-43.475	-103.900	-3-15-	2.6	5.1	3	3.4	4	12	10	0.5	36	53	74
405575	46-43.245	-103.783	-3-15-	3.7	3.3	10	5.0	5	18	20	0.8	92	69	63
405576	46-43.233	-103.767	-3-15-	3.7	3.5	7	5.7	5	19	22	1.0	90	67	54
405577	46-43.220	-103.752	-3-15-	3.6	3.6	5	3.4	5	15	15	0.7	94	83	63
405578	46-43.232	-103.757	-3-15-	3.4	3.9	12	5.6	6	21	27	1.1	100	76	50
405579	46-43.228	-103.735	-3-15-	5.3	6.0	12	6.4	6	24	22	0.9	110	86	65
405580	46-43.236	-103.716	-3-15-	5.5	6.4	7	5.9	10	20	27	0.8	92	100	69
405581	46-43.232	-103.725	-3-15-	5.3	5.6	8	6.4	7	19	17	0.8	80	72	57
405582	46-43.237	-103.751	-3-15-	4.1	5.6	7	6.8	5	20	25	1.4	89	72	50
405583	46-43.246	-103.775	-3-15-	2.5	3.4	10	5.5	6	21	21	1.2	86	84	62
405584	46-43.379	-103.801	-3-15-	3.8	5.6	12	6.1	9	20	20	0.4	85	65	81
405585	46-43.378	-103.799	-3-15-	5.6	7.7	9	3.6	7	12	14	0.8	55	42	82
405586	46-43.377	-103.803	-3-15-	230.	250.	11	15.	11	17	25	13.	360	58	72
405587	46-43.375	-103.808	-3-15-	5.8	6.3	7	4.1	6	10	9	0.9	47	36	71
405588	46-43.379	-103.812	-3-15-	130.	130.	11	84.	10	11	14	74.	390	42	76
405589	46-43.381	-103.814	-3-15-	98.	100.	13	88.	8	10	12	87.	470	38	70
405590	46-43.385	-103.811	-3-15-	4.6	4.5	11		8	13	19		68	54	86
405591	46-43.381	-103.835	-3-15-	4.7	4.2	11	6.1	7	16	18	3.0	78	64	83
405592	46-43.407	-103.842	-3-15-	5.3	4.7	53	4.4	14	15	19	1.6	57	29	63
405593	46-43.410	-103.836	-3-15-	52.	52.	53	4.5	15	18	20	3.9	85	38	77
405594	46-43.411	-103.833	-3-15-	36.	34.	8	3.4	11	15	30	2.5	98	61	91
405595	46-43.412	-103.833	-3-15-	27.	27.	3	3.6	4	11	9	2.0	65	28	66
405597	46-43.411	-103.839	-3-15-	49.	50.	6	3.9	4	10	8	8.1	110	26	63
405598	46-43.267	-103.671	-3-15-	3.9	3.6	4	3.8	6	12	13	1.2	59	44	76
405599	46-43.289	-103.661	-3-15-	5.8	6.4	10	4.7	6	13	12	0.8	59	50	64
405600	46-43.282	-103.658	-3-15-	3.0	3.6	6	3.2	10	12	13	0.4	45	48	61
405601	46-43.273	-103.654	-3-15-	2.9	6.2	5	4.2	7	17	13	0.5	52	49	59
405602	46-43.299	-103.648	-3-15-	1.3	1.7	3	1.9	4	8	7	0.2	32	29	45
405603	46-43.382	-103.847	-3-15-	2.5	3.6	5	3.2	6	14	14	0.4	58	63	62
405604	46-43.388	-103.869	-3-15-	7.3	8.8	5	2.1	6	14	11	0.8	51	58	52
405605	46-43.388	-103.862	-3-15-	2.7	3.7	7	2.9	10	18	22	0.4	76	56	71
405606	46-43.391	-103.857	-3-15-	2.5	3.5	6	2.9	9	15	19	0.4	63	47	68
405607	46-43.405	-103.849	-3-15-	22.	25.	6	4.1	7	13	12	1.3	98	36	61
405608	46-43.405	-103.850	-3-15-	20.	22.	5	3.5	6	12	11	0.6	73	34	64
405609	46-43.412	-103.867	-3-15-	4.4	5.3	3	3.1	5	7	8	0.5	32	19	32
405610	46-43.412	-103.859	-3-15-	12.	15.	4	3.4	5	10	11	1.2	56	29	58
405612	46-43.414	-103.865	-3-15-	2.5	2.4	<2	2.4	<4	5	3	0.2	22	14	45
405613	46-43.427	-103.862	-3-15-	4.9	6.5	<2	2.5	<4	6	5	0.5	28	16	47
405614	46-43.435	-103.852	-3-15-	1.8	1.8	4	2.9	4	5	5	1.2	21	16	35
405615	46-43.407	-103.878	-3-15-	2.4	3.4	10	2.4	6	11	12	0.1	52	44	68
405616	46-43.423	-103.879	-3-15-	1.9	2.4	2	2.9	<4	5	5	0.3	25	20	46
405617	46-43.425	-103.880	-3-15-	3.7	4.2	<2	2.1	4	8	7	0.1	36	22	46
405618	46-43.441	-103.888	-3-15-	1.0	1.6	<2	2.1	<4	7	7	1.7	24	18	39
405619	46-43.445	-103.888	-3-15-	1.7	2.1	2	2.7	<4	5	5	0.6	24	17	41
405620	46-43.448	-103.885	-3-15-	2.1	2.0	<2	2.9	<4	6	5	0.9	25	18	45
405621	46-43.449	-103.876	-3-15-	2.4	2.3	<2	3.7	5	8	7	1.8	27	25	52

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. C. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405622	46-43.454	-103.886	-3-15-	1.9	2.0	4	2.1	4	7	6	0.2	25	18	40
405623	46-43.537	-103.991	-3-15-	2.8	3.6	<2	3.0	5	9	7	1.0	37	24	71
405624	46-43.537	-103.992	-3-15-	2.5	3.2	<2	2.6	4	8	7	1.0	40	32	57
405625	46-43.551	-103.978	-3-15-	1.9	1.8	2	1.9	5	10	12	1.6	42	42	58
405626	46-43.553	-103.978	-3-15-	1.9	1.9	5	2.0	5	11	13	0.6	44	44	55
405627	46-43.557	-103.981	-3-15-	2.2	1.9	3	2.1	5	11	12	0.5	45	53	55
405628	46-43.557	-103.977	-3-15-	1.5	1.9	6	3.4	7	13	18	0.2	48	36	60
405629	46-43.547	-103.974	-3-15-	1.8	2.2	7	2.6	7	14	14	0.6	60	67	67
405630	46-43.544	-103.968	-3-15-	2.9	2.9	6	4.5	9	19	21	1.0	65	67	62
405631	46-43.540	-103.967	-3-15-	2.6	2.2	4	3.4	6	13	16	0.9	48	42	66
405632	46-43.540	-103.966	-3-15-	2.5	2.2	5	2.2	4	9	12	0.6	35	31	65
405633	46-43.531	-103.968	-3-15-	2.8	3.4	5	2.6	7	17	17	0.4	69	71	80
405634	46-43.526	-103.966	-3-15-	3.8	4.3	3	2.7	6	17	14	0.4	69	70	78
405635	46-43.519	-103.968	-3-15-	2.1	2.6	4	3.2	5	10	9	0.4	40	36	68
405636	46-43.507	-103.974	-3-15-	3.9	5.7	9	7.8	7	16	14	0.7	89	65	78
405637	46-43.514	-103.953	-3-15-	1.1	2.0	6	1.6	5	10	7	0.2	41	27	48
405638	46-43.515	-103.953	-3-15-	2.4	3.3	3	2.8	5	11	9	0.4	43	39	81
405639	46-43.502	-103.977	-3-15-	2.3	3.0	9	5.0	11	19	26	0.3	79	68	67
405640	46-43.501	-103.985	-3-15-	2.0	2.6	6	4.0	8	17	22	0.6	64	57	68
405641	46-43.513	-103.980	-3-15-	2.2	2.7	50	3.3	17	21	27	0.4	60	50	82
405643	46-43.519	-103.985	-3-15-	2.5	3.3	46	7.6	14	15	19	0.6	52	43	69
405644	46-43.521	-103.986	-3-15-	3.8	4.5	6	5.9	5	10	10	0.9	51	32	61
405645	46-43.537	-103.929	-3-15-	1.6	2.0	5	2.6	5	11	12	0.1	41	37	68
405646	46-43.541	-103.936	-3-15-	1.9	2.6	4	3.2	8	17	17	0.4	63	63	73
405647	46-43.541	-103.938	-3-15-	2.0	2.6	6	2.9	7	16	15	<0.1	64	62	71
405648	46-43.546	-103.928	-3-15-	2.0	2.6	5	3.3	8	16	18	0.4	59	48	78
405649	46-43.545	-103.928	-3-15-	2.2	2.5	3	3.8	7	14	15	1.0	48	50	65
405650	46-43.551	-103.935	-3-15-	1.9	2.3	9	4.0	7	13	17	0.5	50	40	65
405651	46-43.550	-103.941	-3-15-	2.1	2.5	7	3.8	8	16	17	0.5	64	60	69
405652	46-43.549	-103.949	-3-15-	1.8	2.1	5	2.6	6	12	13	0.3	49	47	68
405653	46-43.546	-103.946	-3-15-	1.6	2.1	12	2.0	6	13	13	0.6	54	56	68
405654	46-43.548	-103.955	-3-15-	1.8	2.4	7	2.3	7	14	17	0.4	61	63	69
405683	46-43.469	-103.925	-3-15-	2.8	3.1	5	2.7	6	12	11	0.6	46	43	69
405684	46-43.460	-103.927	-3-15-	1.4	2.1	3	4.1	4	9	8	0.8	33	32	55
405685	46-43.458	-103.930	-3-15-	2.6	3.0	4	3.9	6	13	14	0.7	55	47	73
405686	46-43.445	-103.932	-3-15-	2.1	3.3	6	3.2	7	14	14	0.3	63	46	78
405687	46-43.442	-103.935	-3-15-	3.2	3.8	7	3.1	8	15	16	0.2	62	39	78
405689	46-43.439	-103.934	-3-15-	2.0	2.8	4	3.3	6	12	13	0.4	51	39	71
405690	46-43.460	-103.920	-3-15-	1.6	2.4	5	3.2	5	10	11	0.6	45	34	54
405841	46-43.573	-103.977	-3-15-	1.7	2.0	6	3.7	5	10	14	0.2	36	38	55
405842	46-43.565	-103.979	-3-15-	1.6	2.3	12	3.4	6	10	15	0.2	37	33	65
405843	46-43.565	-103.981	-3-15-	2.0	2.4	4	3.5	6	12	15	0.3	38	33	77
405844	46-43.566	-103.988	-3-15-	1.3	2.2	6	3.8	6	13	14	<0.1	38	32	67
405845	46-43.564	-103.986	-3-15-	2.1	2.8	4	3.6	5	11	13	<0.1	36	29	81
405846	46-43.550	-103.975	-3-15-	2.3	3.4	7	4.9	9	19	23	0.5	67	60	74
405847	46-43.550	-103.973	-3-15-	3.1	3.7	6	6.9	12	24	27	0.4	86	110	65
405848	46-43.571	-103.954	-3-15-	1.4	2.0	3	3.1	4	8	8	0.2	32	32	48
405849	46-43.592	-103.944	-3-15-	2.3	2.7	4	3.6	5	10	14	0.3	38	36	74
405850	46-43.592	-103.946	-3-15-	3.[illegible]	3.3	8	4.1	8	16	21	0.3	59	57	67
405851	46-43.568	-103.954	-3-15-	2.3	2.7	4	3.4	4	10	12	<0.1	34	32	98
405852	46-43.557	-103.946	-3-15-	1.6	2.1	5	3.1	5	10	11	0.3	36	47	62
405853	46-43.552	-103.958	-3-12-	2.5	3.0	8	4.7	8	16	20	0.4	60	52	80
405854	46-43.552	-103.931	-3-15-	2.0	2.7	6	3.1	5	11	14	0.2	41	36	61
405855	46-43.553	-103.929	-3-12-	2.5	3.1	5	5.0	9	18	24	<0.1	64	58	80
405856	46-43.554	-103.931	-3-15-	1.3	2.6	8	4.4	8	16	19	0.2	56	46	66

Table B-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE EDGEMONT DETAILED GEOCHEMICAL SURVEY, SOUTH DAKOTA; WYOMING

EDGEMONT DETAILED SURVEY SEDIMENTS

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U-FL (PPM)	U-NT (PPM)	TH (PPM)	AS (PPM)	CO (PPM)	CU (PPM)	NI (PPM)	SE (PPM)	V (PPM)	ZN (PPM)	ZR (PPM)
405857	46-43.556	-103.912	-3-12-	1.9	2.6	6	4.4	7	14	17	0.2	53	47	70
405858	46-43.556	-103.908	-3-12-	2.3	3.0	7	4.9	9	17	21	<0.1	60	58	69
405859	46-43.552	-103.912	-3-15-	1.2	2.3	6	2.7	6	14	13	0.4	45	43	62
405860	46-43.545	-103.902	-3-15-	1.6	2.2	3	3.1	6	14	12	0.5	40	45	65
405861	46-43.518	-103.906	-3-15-	2.0	2.7	2	1.8	4	9	7	<0.1	35	39	54
405862	46-43.517	-103.906	-3-15-	2.3	2.6	2	2.5	4	9	8	1.9	37	38	63
405863	46-43.514	-103.883	-3-15-	2.1	2.7	<2	4.1	4	9	8	0.2	35	39	58
405864	46-43.512	-103.883	-3-15-	2.6	3.1	4	3.3	4	10	9	0.6	40	59	62
405865	46-43.542	-103.899	-3-15-	1.7	1.8	4	2.0	5	10	13	<0.1	42	39	67
405866	46-43.542	-103.897	-3-15-	1.8	2.1	<2	2.3	5	9	13	0.4	40	37	72
405868	46-43.507	-103.869	-3-15-	2.6	3.1	7	1.9	5	13	13	0.6	54	55	68
405869	46-43.509	-103.862	-3-15-	1.7	2.1	6	1.7	4	12	10	0.4	44	55	63
405870	46-43.509	-103.863	-3-15-	1.9	1.9	9	2.0	5	12	11	0.3	48	55	66
405872	46-43.396	-103.912	-3-15-	2.0	3.5	3	9.0	4	12	9	0.1	37	38	61
405873	46-43.395	-103.910	-3-15-	2.6	3.4	10	3.1	7	20	17	0.3	64	71	75
405874	46-43.406	-103.919	-3-15-	2.3	2.8	4	2.7	4	11	8	0.3	37	39	65
406421	46-43.441	-103.967	-3-15-	2.9	3.8	7	5.1	8	19	17	0.2	80	72	78
406422	46-43.441	-103.966	-3-15-	2.9	3.7	6	5.4	9	24	20	0.7	100	86	84
406423	46-43.434	-103.955	-3-15-	4.5	5.1	12	4.5	10	25	27	0.2	110	91	100
406424	46-43.440	-103.952	-3-15-	3.1	3.8	9	3.8	10	20	20	0.1	70	54	83
406425	46-43.438	-103.951	-3-15-	2.6	3.5	8	4.7	14	23	24	0.8	68	63	74
406426	46-43.450	-103.949	-3-15-	5.1	5.5	24	5.5	21	31	44	0.4	130	92	110
406428	46-43.436	-103.957	-3-15-	4.0	4.1	21	5.5	14	26	26	0.6	97	86	96
406429	46-43.445	-103.968	-3-15-	2.4	3.2	7	4.8	8	18	16	0.4	81	73	78
406431	46-43.431	-103.967	-3-15-	3.0	3.7	5	5.1	8	14	14	0.5	60	66	61
406435	46-43.391	-103.913	-3-12-	2.2	3.5	3	1.9	7	15	14	0.4	63	59	75
406436	46-43.384	-103.911	-3-12-	2.1	3.4	7	2.9	7	16	13	0.4	65	61	77
406437	46-43.390	-103.909	-3-15-	1.8	2.8	3	2.2	4	14	10	0.7	50	47	59
406490	46-43.272	-103.745	-3-12-	2.6	3.3	7	3.9	7	15	16	0.4	70	54	73
406491	46-43.270	-103.745	-3-12-	3.4	4.1	9	5.3	8	21	22	0.3	98	79	77
406492	46-43.266	-103.746	-3-12-	6.5	7.4	8	7.1	19	32	73	0.6	130	150	88
406493	46-43.266	-103.745	-3-15-	3.0	3.6	7	4.7	12	20	19	3.1	90	76	74
406494	46-43.262	-103.718	-3-15-	2.4	3.2	6	3.7	6	11	9	0.8	45	37	60
406495	46-43.253	-103.714	-3-15-	2.2	3.2	6	4.2	5	10	13	0.2	53	55	37

APPENDIX C

FIELD FORM AND DETECTION LIMITS

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APPENDIX C

FIELD FORM AND DETECTION LIMITS

LIST OF TABLES

No.	Title	Page
C-1	Computer Code List of Geochemical Variables . . .	C-4
C-2	Oak Ridge Geochemical Sampling From Showing Field Data Recorded on Microfiche	C-5

Table C-1

COMPUTER CODE LIST OF GEOCHEMICAL VARIABLES

Variable[a]	Code	Variable[a]	Code
Uranium Measured by Fluorometry[b]	U-FL	Yttrium	Y
Uranium Measured by Mass Spectrometry[b]	U-MS	Zinc	ZN
		Zirconium	ZR
Uranium Measured by Neutron Activation	U-NT	Sulfate (ppm)	SO, SO_4
		Chloride (ppm)	CL
Arsenic	AS	Fluoride (ppm)	F
Selenium	SE	Specific Conductance (μmhos/cm)	SP
Silver	AG	Dissolved Oxygen (ppm)	DO
Aluminum	AL	Temperature (°C)	TP, TEMP
Boron	B	pH	PH
Barium	BA	Total Alkalinity (ppm)	T-AK
Beryllium	BE	P Alkalinity (ppm)	P-AK, LIP
Calcium	CA	M Alkalinity (ppm)	M-AK
Cerium	CE	Carbonate (ppm)	CB
Cobalt	CO	$CB = \begin{cases} 0 & \text{if pH} \le 8.3 \\ \frac{3.42 \times \text{M-Alkalinity}}{5.61 + 10^{(11-pH)}} & \text{if pH} > 8.3 \end{cases}$	
Chromium	CR		
Copper	CU		
Iron	FE		
Hafnium	HF	Bicarbonate (ppm)	BC
Mercury	HG	$BC = \begin{cases} \frac{2.62 \times \text{M-Alkalinity}}{4.3 + 10^{(7-pH)}} & \text{if pH} \le 8.3 \\ 0.61 \times \text{M-Alkalinity} - CB & \text{if pH} > 8.3 \end{cases}$	
Potassium	K		
Lanthanum	LA		
Lithium	LI	U-NT/U-FL	U/U, TU/U
Magnesium	MG	U-FL/U-NT	U/TU
Manganese	MN	TH/U-NT	TH/U
Molybdenum	MO	1,000·U/SP	U/SP
Sodium	NA	1,000·U/B	U/B
Niobium	NB	1,000·U/SO	U/SO, USO
Nickel	NI	Sodium/Chloride	NA/C
Phosphorus	P	Helium/Neon	H/N
Lead	PB	Total Alkalinity/Sulfate	A/SO
Platinum	PT	Total Gamma (cps)	TGAM
Radon	RN	Equivalent Uranium (ppm)	EU
Scandium	SC	Counts Per Minute Uranium (cpm)	CPU
Silicon	SI	Equivalent Potassium (%)	EK
Tin	SN	Counts Per Minute Potassium (cpm)	CPK
Strontium	SR	Equivalent Thorium (ppm)	ETH
Thorium	TH	Counts Per Minute Thorium (cpm)	CPTH
Titanium	TI	Total Counts (cpm)	TOT
Vanadium	V		

(a) If natural logarithm of variable is used, L or L- precedes the variable code.

(b) If method is not specified for waters, U-FL is used, except where value is below laboratory detection limit in which case U-MS is substituted if it is available.

Table C-2

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

OAK RIDGE GEOCHEMICAL SAMPLING FORM

1 — 1 Card Number

GENERAL SITE DATA

Attach Identical Sample Number Here
2 3 4 5 6 7

8 9 10 11 Site Number

12 13 14 15 – 16 17 Map Code

Sample Type (18)

M	Stream Sediment
H	Lake Sediment
S	Stream Water
W	Well Water
P	Spring Water
L	Lake Water
A	Bog Water
B	Plant
F	Soil (Use Remarks)
G	Rock
Ø	Other

19 Replicate Letter (A–Z)

Hour (20 21) Day (22 23) Month (24 25) Year (26 27)

28 29 30 Collector's Initials

31 Phase (P, 1, 2, or G)

Field Sheet Status (32)

Ø	Original
C	Correction
V	Voiding

Control Sample (33)

A	Sediment, High U
B	Sediment, Low U
C	Water, High U
D	Water, Low U
Ø	Other

34 35 36 37 Air Temperature (°C)

Location

Latitude: Deg. (38 39) Min. (40 41) Sec. (42 43); Longitude: Deg. (44 45 46) Min. (47 48) Sec. (49 50)

51 52 53 54 Surface Geologic Unit Code

UCN-11882
(1 8-77)

Type of Vegetation (55) (Within 1 Km Upstream)

C	Conifer
&	Conifer & Deciduous
D	Deciduous
B	Brush
G	Grass
M	Moss
L	Lichen
Ø	Other

Density of Vegetation (56) (Within 1 Km Upstream)

B	Barren
S	Sparse
M	Moderate
D	Dense
V	Very Dense

Local Relief (57) (Within 1 Km Upstream)

F	Flat	(<2m)
L	Low	(2–15m)
G	Gentle	(15–60m)
M	Moderate	(60–300m)
H	High	(>300m)
Ø	Other	

Weather

58		59	
C	Calm	C	Clear
P	Lt Wind	L	Pt Cldy
V	Windy	W	Overcast
R	V. Windy	V	Rainy
S	Gale	G	Snowy

Classes of Contaminants (60)

N	None
M	Mining (Use Remarks)
A	Agriculture
F	Oil Field
I	Industry
S	Sewage
P	Power Plant
U	Urban
Ø	Other

Average Stream Velocity (m/sec) (61 62 63)
N = No Visible Movement
P = Stagnant Pool

64 65 66 Water Width (m)

67 68 69 Average Depth (m)

Water Level (70)

D	Dry	N	Normal
P	Pools	H	High
L	Low	F	Flood

Dominant Bed Material (71)

B	Boulder
C	Cobble
P	Pebble
S	Sand
T	Silt
Y	Clay
N	None (Use Remarks)

Sample Color (Except Plants)

Adj (72 73) Noun (74 75 76)

V	V Lt	PK	Pink
L	Light	RD	Red
M	Medium	GN	Green
D	Dark	BU	Blue
		BN	Brown
CL	Clear	GY	Gray
WH	White	BK	Black
YL	Yellow	ØT	Other
ØR	Orange		

Odor of Sampled Material (77)

N	None
S	H_2S
Ø	Other

78 R Results Request (Use Remarks)

1 — 2 Card Number

PLANT SAMPLE

18 19 Number of Plants Sampled (Number of grabs for moss)

20 21 22 Trunk Diameter (m) (1 m above ground)

23 24 25 Plant Height (m) (Average of Plants Sampled)

Name of Tree, Deciduous (26)

R	Alto Verde	U	Locust
A	Ash	P	Maple
B	Beech	M	Mesquite
I	Birch	K	Oak, Other
D	Box Elder	V	Olive
F	Cherry	Y	Poplar
N	Cottonwood	S	Sycamore
E	Elm	T	Salt Cedar
H	Hackberry	G	Walnut
C	Hickory	X	Willow
W	Huisache	Ø	Other
L	Live Oak		

Name of Tree, Conifer (27)

A	N. Wh. Cedar	L	Larch
C	Cedar, Other	P	Pine
F	Fir	S	Spruce
H	Hemlock	Ø	Other
J	Juniper		

Name of Bush (28)

A	Alder	W	Witch Hazel
B	Blueberry	Y	Yew
P	Pussy Willow	Ø	Other

Name of Moss (29)

P	Peat
S	Sphagnum (live)
Ø	Other

Algae (30)

G	Blue-Green
B	Brown
Ø	Other

Table C-2, Continued

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

STREAM OR LAKE SEDIMENT

Sample Condition

31
- D Dry
- W wet

Sample Treatment

32
- N None
- S Sieved
- Ø Other

33 34 Number of Grabs

35 36 % Organic Material (Field Estimate)

GENERAL WATER SAMPLES

Water Sample Treatment

37
- N None
- F Filtered Only
- C Acidified Only
- A Acidified and Filtered
- Ø Other

Depth of Visibility (m)

38 39 40 C = Clear

41 42 43 44 45 Conductivity (μmhos/cm)

46 47 48 Dissolved O_2 (ppm)

49 50 51 Temperature (°C)

52 53 54 pH

55 P pH by Lo-Ion Paper

56 57 58 59 Total Alkalinity (ppm)

60 61 62 63 P Alkalinity (ppm)

64 65 66 67 M Alkalinity (ppm)

Appearance of Water

68
- C Clear
- M Murky
- A Algal
- Ø Other

69 70 71 72 73 Discharge (liters/min)

74 75 76 77 Identification of Producing Horizon (Geologic Unit Code)

Confidence of Producing Horizon Identification

78
- H High Degree
- R Probable
- S Possible

Source of Producing Horizon Identification

79
- P Publication
- W Owner
- U User
- G Geologic Inference
- Ø Other

1 3 Card Number

WELL WATER

Type of Well

18
- D Drilled
- P Drive Point
- G Dug
- U Unknown
- Ø Other

Power Classification

19
- A Artesian Flow
- E Electric
- G Gasoline
- W Wind
- H Hand
- Ø Other

Casing

20
- N None (Below Water Table)
- S Steel
- G Galvanized
- P Plastic
- U Unknown
- Ø Other

Pipe Composition

21
- F Steel
- Z Galvanized
- C Copper
- P Plastic
- U Unknown
- Ø Other

Sample Location

22 23 24 Meters from Well Head
H = Holding Tank (Use Remarks)

Where Sample Taken With Respect To Pressure Tank

25
- B Before
- A After
- N No Pressure Tank
- F From Pressure Tank (Use Remarks)

Use of Well

26
- M Municipal
- H Household
- S Stock
- I Irrigation
- A All of above
- X H and S
- Y H and I
- Z S and I
- N None
- Ø Other

Frequency of Pumping

27
- C Constant (hourly)
- F Frequent (daily)
- I Infrequent (weekly)
- R Rare (no recent use)

Depth to top of Producing Horizon

28 29 30 31 (Meters)

Confidence of Producing Depth

32
- H High
- R Probable
- S Possible

Source of Producing Depth Information

33
- P Publication
- W Owner
- U User
- G Geologic Inference
- Ø Other

Total Well Depth

34 35 36 37 (Meters)

Confidence of Total Depth

38
- H High
- R Probable
- S Possible

Source of Total Depth Information

39
- P Publications
- W Owner
- U User
- G Geologic Inference
- Ø Other

LAKE WATER

Type of Lake

65
- N Natural
- M Manmade

Lake Area

66 67 68 69 (sq km)

REMARKS (Card 4)

Table C-2, Continued

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

OAK RIDGE GEOCHEMICAL SAMPLING FORM

FIELD DATA SUPPLEMENT

Attach Identical
Sample Number Here

Sequence Number

1

Procedure Number

Results for Procedure 31

Total Gamma - Scintillometer (counts/minute)

Results for Procedures 34-41

Variables and Procedures
are listed below

Results for Procedure 32 Gamma Spectrometer

TOTAL COUNTS (CPM)

e POTASSIUM (%)

POTASSIUM (CPM)

e URANIUM (ppm)

URANIUM (CPM)

e THORIUM (ppm)

THORIUM (CPM)

Note To Sampler: Blocks 16-20 Not Used Should Be Marked Out.

DO NOT KEYPUNCH

Procedures 34—41

34 Uranium (ppb)
35 Fluoride (ppm)
36 Nitrate (ppm)
37 Sulphate (ppm)
38 Phosphate (ppm)
39 Ferrous Iron (ppm)
40 Total Iron (ppm)
41 Turbidity (% T)

Readings made in Counts per ______

VARIABLE	READING		BACKGROUND		RESULTS
	ACTUAL	CPM	ACTUAL	CPM	
TOTAL COUNTS					
POTASSIUM					
URANIUM					
THORIUM					

UCN-11992A
(1 3-79)

APPENDIX D

MICROFICHE OF FIELD AND LABORATORY DATA

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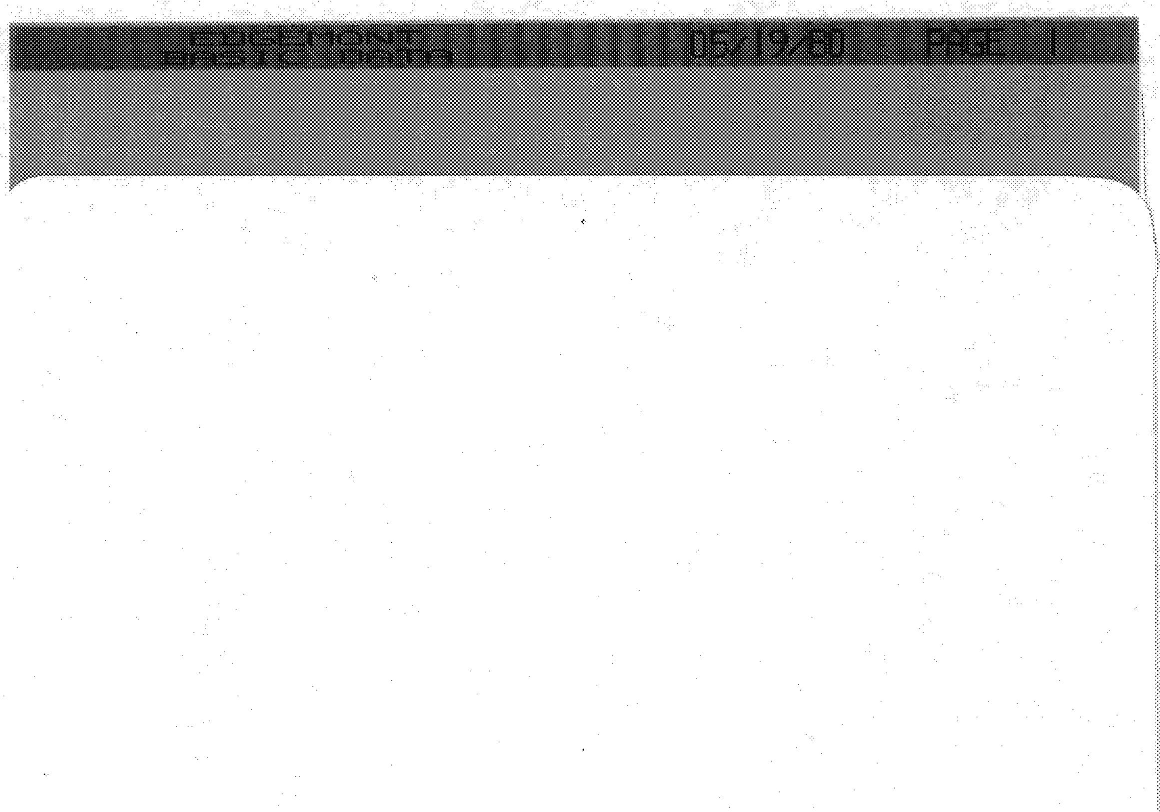
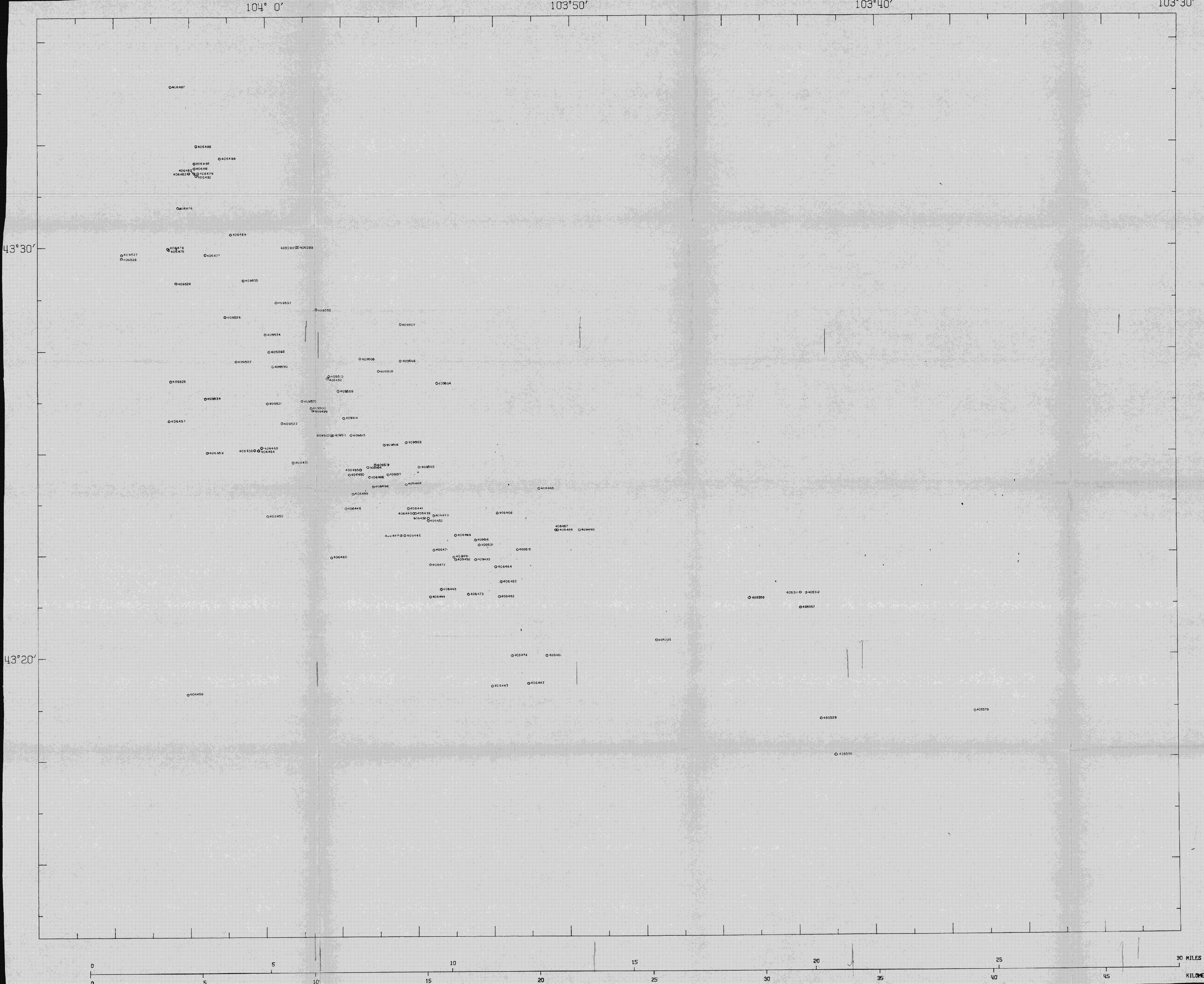
MICROFICHE OF FIELD AND LABORATORY DATA

CONTENTS

Laboratory Data	Page
Well Water (W)	1- 6
Stream Sediment (M)	7-30

Field Data	
Page 1	32-188

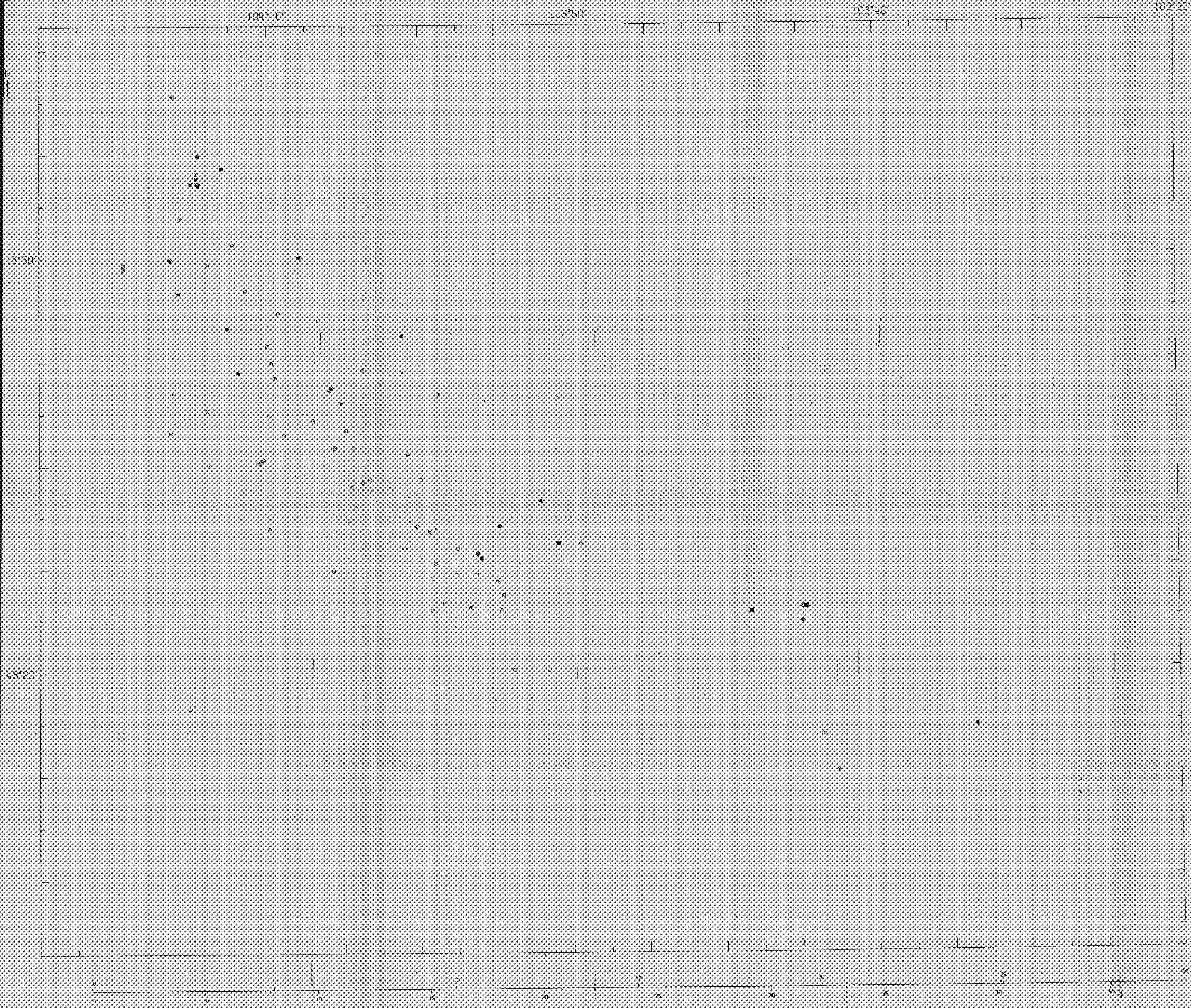




LEGEND
- WELL WATER
- SPRING WATER

PLATE I
EDGEMONT DETAILED
GEOCHEMICAL SURVEY
GROUNDWATER SAMPLE
LOCATION MAP

SCALE 1: 62500
109 SAMPLES PLOTTED



SYMBOL RANGES FOR PLOTTED VARIABLE (X)

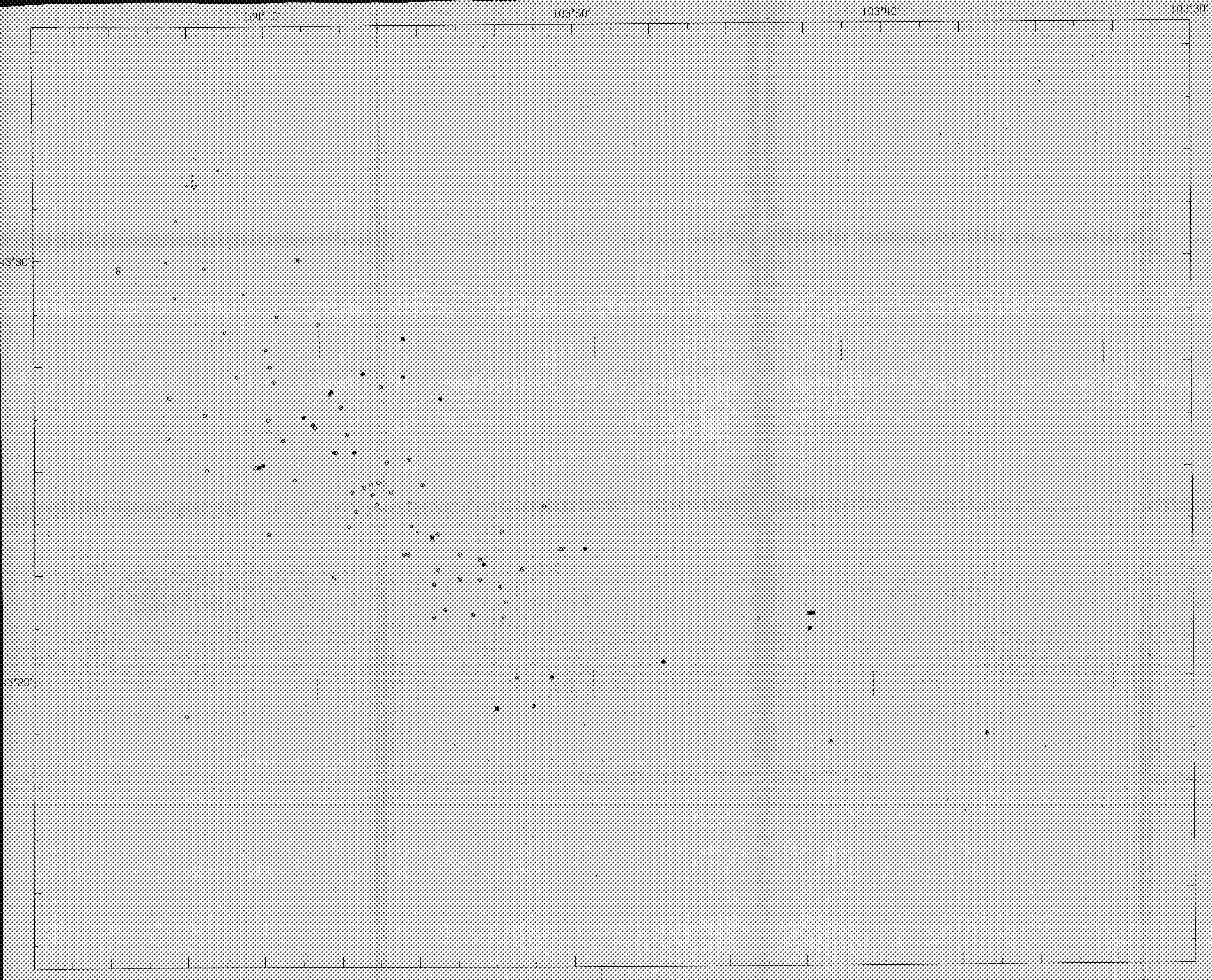
0.0 ≤ X <	0.20
0.20 ≤ X <	0.25
0.25 ≤ X <	0.43
0.43 ≤ X <	0.76
0.76 ≤ X <	2.83
2.83 ≤ X <	7.35
7.35 ≤ X <	15.24
15.24 ≤ X <	22.17
22.17 ≤ X <	36.54
36.54 ≤ X <	74.22
X ≥	74.22

PLATE 2
EDGEMONT DETAILED GEOCHEMICAL SURVEY SYMBOL PLOT GROUNDWATER

URANIUM (PPB)

SCALE 1: 62500

109 SAMPLES PLOTTED



SYMBOL RANGES FOR PLOTTED VARIABLE (X)

287	≤	X	<	852
852	≤	X	<	1115
1115	≤	X	<	1223
1223	≤	X	<	1319
1319	≤	X	<	1484
1484	≤	X	<	1660
1660	≤	X	<	1922
1922	≤	X	<	2274
2274	≤	X	<	3014
3014	≤	X	<	3334
3334	≤	X	<	3839
3839	≤	X	<	4676
4676	≤	X	<	5740
		X	≥	5740

PLATE 3
EDGEMONT DETAILED GEOCHEMICAL SURVEY SYMBOL PLOT GROUNDWATER

SPECIFIC CONDUCTANCE (UMHOS/CM)

0 5 10 15 20 25 30 MILES

0 5 10 15 20 25 30 35 40 45 KILOMETERS

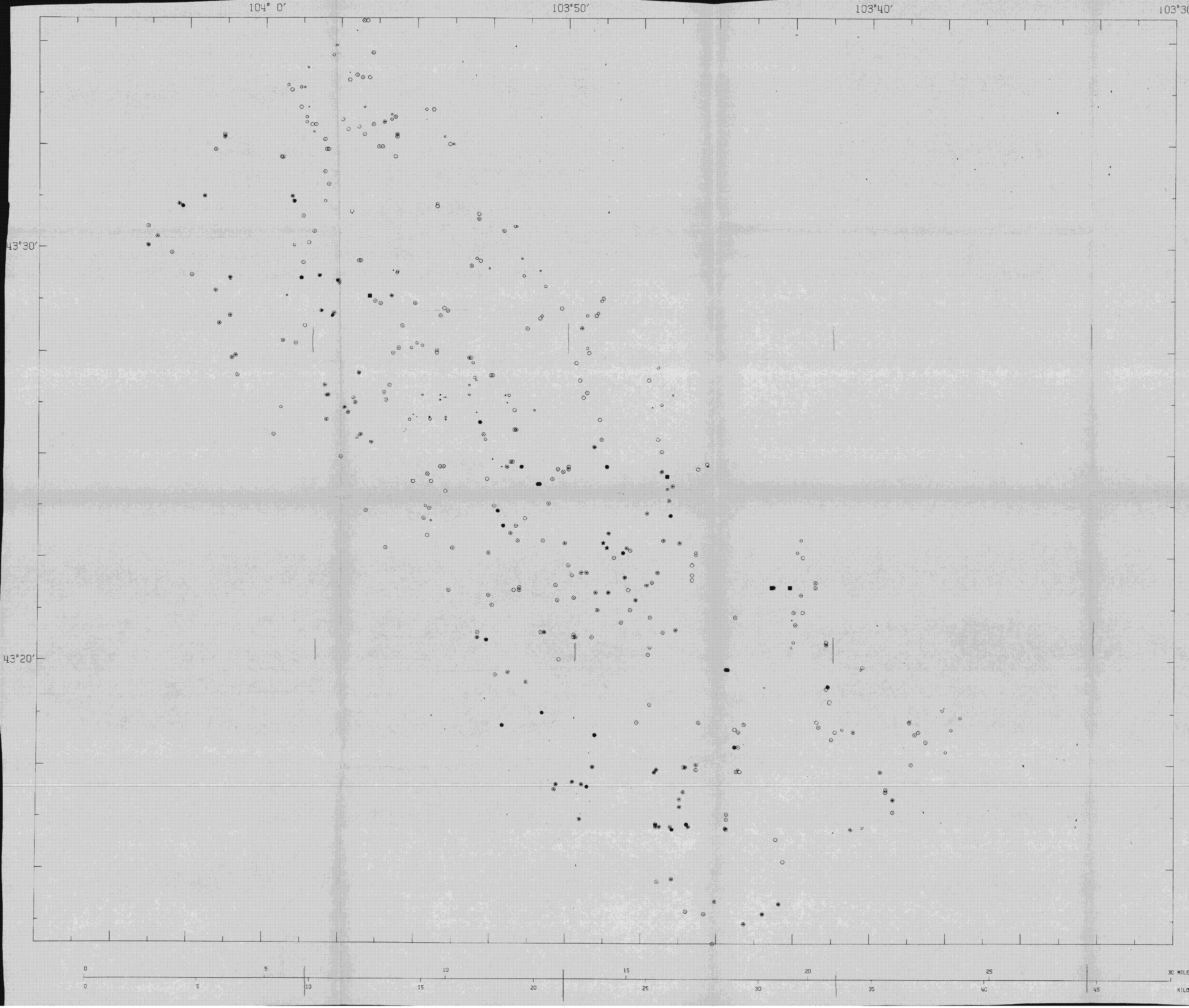
SCALE 1: 62500

109 SAMPLES PLOTTED

PLATE 4
EDGEMONT DETAILED
GEOCHEMICAL SURVEY
SAMPLE LOCATION
AND DRAINAGE BASIN MAP

0 5 10 15 20 25 30 MILES
0 5 10 15 20 25 30 35 40 45 KILOMETERS

SCALE 1: 62500
419 SAMPLES PLOTTED



SYMBOL RANGES FOR PLOTTED VARIABLE (X)

·	$0.25 \le X < 1.09$
·	$1.09 \le X < 1.32$
·	$1.32 \le X < 1.53$
o	$1.53 \le X < 1.81$
○	$1.81 \le X < 2.11$
○	$2.11 \le X < 2.51$
◎	$2.51 \le X < 3.06$
◎	$3.06 \le X < 3.99$
◉	$3.99 \le X < 5.50$
◉	$5.50 \le X < 7.04$
●	$7.04 \le X < 15.10$
●	$15.10 \le X < 51.22$
■	$51.22 \le X < 132.77$
★	$X \ge 132.77$

PLATE 5
EDGEMONT DETAILED GEOCHEMICAL SURVEY SYMBOL PLOT SEDIMENT

URANIUM (PPM)

SCALE 1: 62500

419 SAMPLES PLOTTED

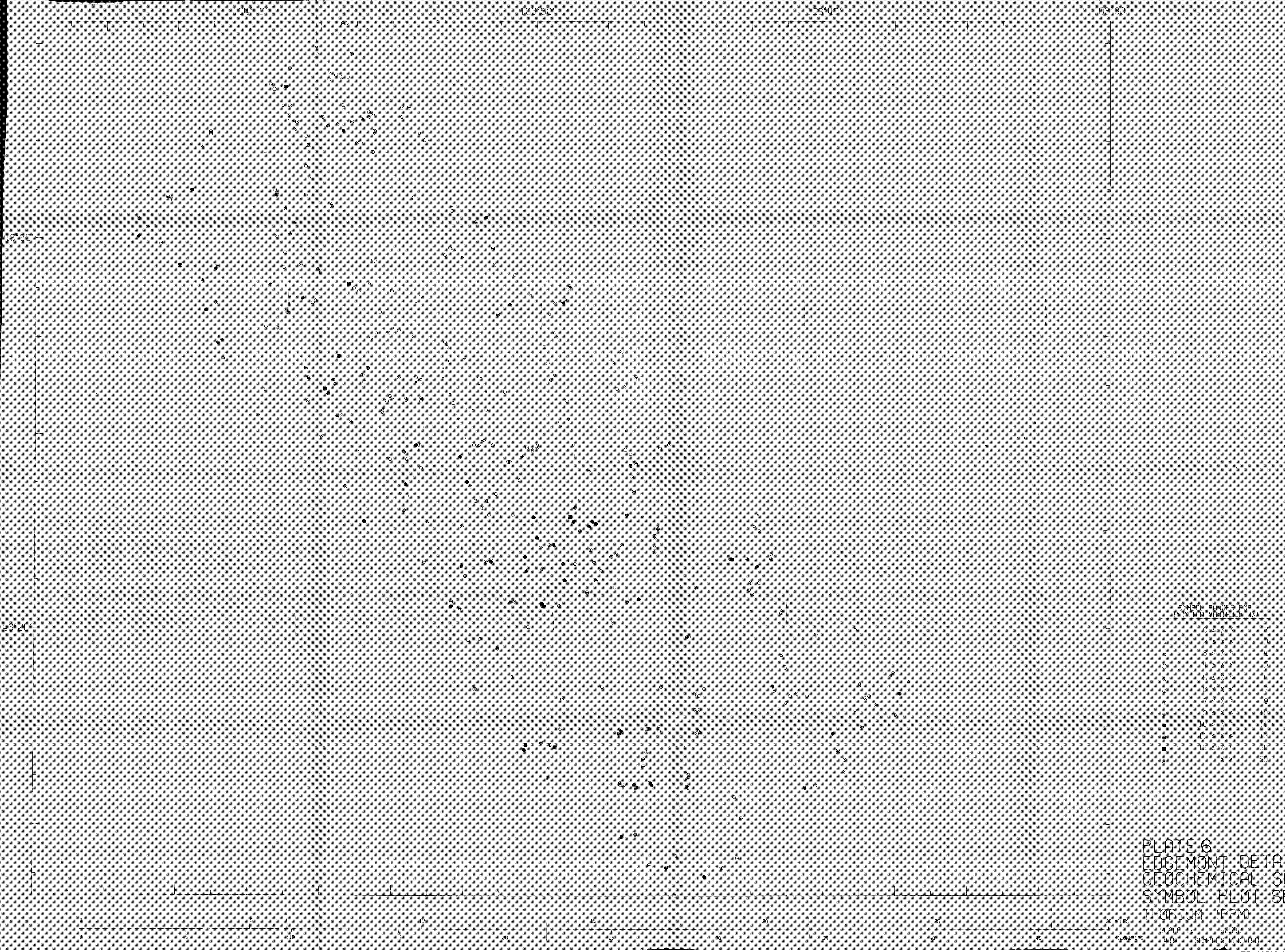


PLATE 6
EDGEMONT DETAILED
GEOCHEMICAL SURVEY
SYMBOL PLOT SEDIMENT
THORIUM (PPM)

SCALE 1: 62500
419 SAMPLES PLOTTED

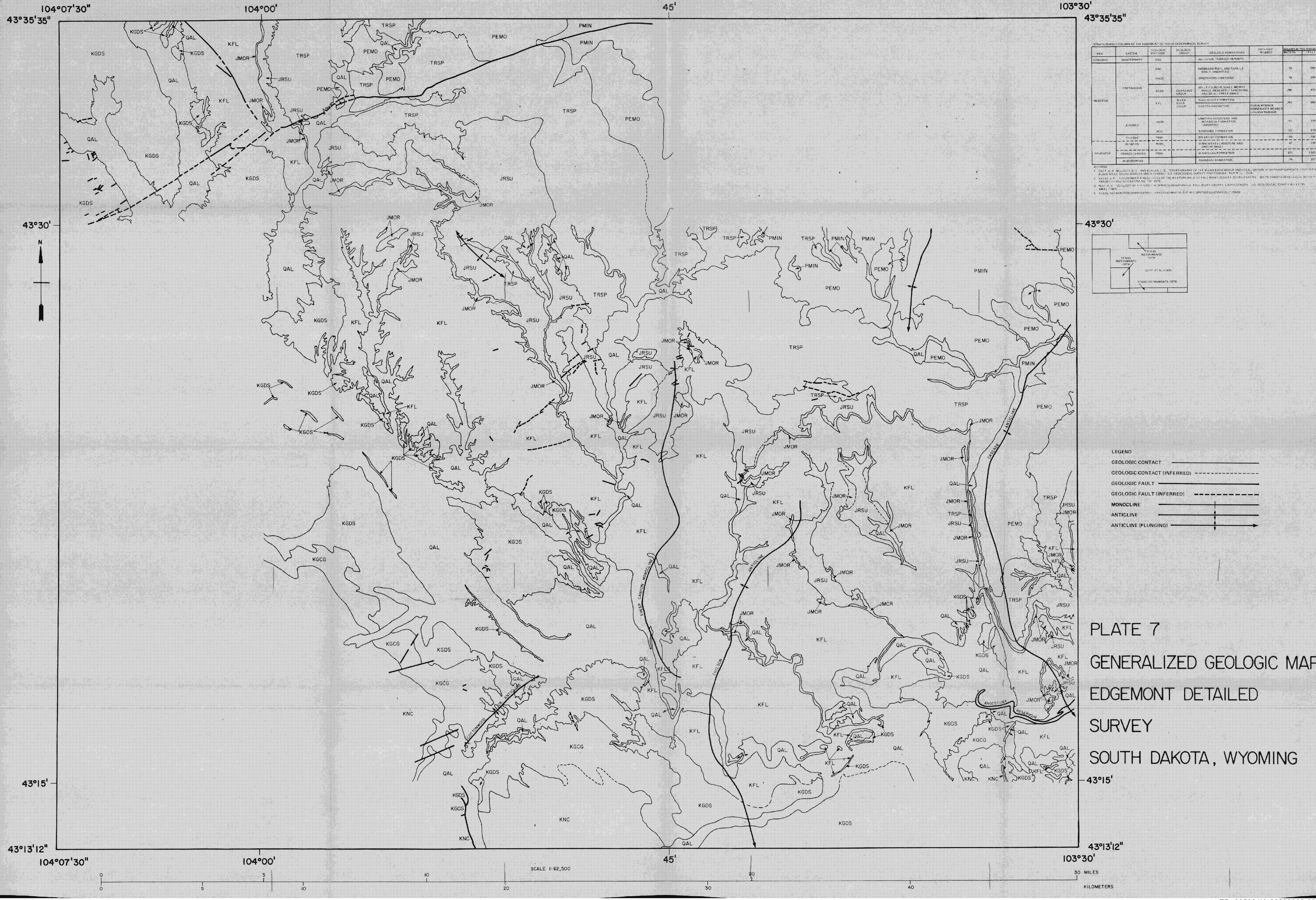


PLATE 7

GENERALIZED GEOLOGIC MAP

EDGEMONT DETAILED SURVEY

SOUTH DAKOTA, WYOMING